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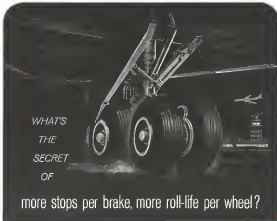
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AVIATION CALENDAR

- (Continued from page 1)
- International Aeronautical Federation
Cherch House, Windsor, Ontario, Canada
 - Sept. 12—Conference on physical climate by an aerodynamic and space flight. University of Pennsylvania, Philadelphia, Pa.
 - Sept. 14—Air Force Office of Scientific Research and General Electric Co. 1st Missile and Space Vehicle Dept.
 - Sept. 24-26—1969 Congress Engineering Conference, University of California, Berkeley, Calif.
 - Sept. 24-26—National Committee and Aerospace Personnel Air Force, Air, Navy, Air Force Hall, Miami Beach, Fla.
 - Sept. 24-26—1969 Farnborough Flight Display and Exhibition Society of British Aircraft Constructors, Farnborough, Eng.
 - Sept. 24-26—South Malvern Conference on Fluid and Solid Mechanics, University of Texas, Austin, Tex. Sponsors: AFOSR, Directorate of Aeronautical Sciences, Office of Naval Research, National Science Foundation.
 - Sept. 24-26—1969 Midwest Quality Control Conference, American Society for Quality Control, Skidmore Hall, French Lick, Ind.
 - Sept. 26-27—Western Regional Meeting on Frontiers in Science and Engineering, Institute of the Aeronautical Sciences, Los Angeles, Calif.
 - Sept. 28-29—1969 Annual Conference and Exhibit, Instrument Society of America, Chicago, Ill.
 - Sept. 29-30—Conference on Planning and Designing of Urban Transportation Facilities, Institute of Aeronautical Sciences, Los Angeles, Calif. Sponsors: Los Angeles Chapter of Engineers.
 - Sept. 31-32—38th Annual Meeting, Standards Engineering Society, on International Standards, National Hotel, Boston, Mass.
 - Sept. 29-30—Engine and Operations Symposium, Aero Corp., Moline, Ill.
 - Sept. 29-30—1969 National Symposium on Telecommunications, Convention and Visitors Hotel, San Francisco, Calif. Sponsors: Institute of Radio Engineers, Professional Group on Space Electronics & Telephony.
 - Sept. 30-Oct. 2—1969 Annual Meeting, Astronautics Society, Marquette Hotel, Washington, D.C.
 - Oct. 1-5—1969 Annual Meeting, American Astronautical Society, Institute of the Aeronautical Sciences, Hotel Astor, New York, N.Y.
 - Oct. 5-10—National Aeronautics Meeting, Society of Automotive Engineers, the Automobile, Los Angeles, Calif.
 - Oct. 5-10—1969 Annual Meeting, National Institute of Standards, Gaithersburg, Md.
 - Oct. 6-8—International Symposium on High Temperature Technology, National Committee, Colorado, Mountain View, Calif. Sponsors: Stanford Research Institute.
 - Oct. 8-10—Society of Experimental Fluids, Symposium on Fluids, Role in Space Exploration, Beverly Hills Hotel, Beverly Hills, Calif. Third Annual Meeting, Newport, Oct. 18.
 - Oct. 12-14—1969 National Electronics Conference, Hotel Sherman, Chicago, Ill.
 - Oct. 12-14—1969 General Convention of the International Air Transport Association, Japan.



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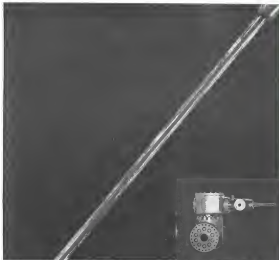
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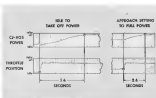
CJ-805 Maturity—CJ-805 production engines, identical to those flying on CF-690s, have already demonstrated ruggedness and maturity in thousands of flight and factory test hours. Two engines have completed 3000-hour ground tests—one of these is now flying in GE's latest B-66, approaching 3000 hours total time. Pilots flying CJ-805 powered aircraft will have an engine whose design and operating maturity have been fully proven.

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10-18

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CONVAIR FLIGHT TEST PILOTS flying B-66 evaluations are Don Greenwald, left, and Paul Forth, right, second Greenwald. "The G-E CJ-805 proved to me that it has power when you need it." From their point of view, the CJ-805 is a pilot's engine.

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GPL data handling equipment for the Federal Aviation Agency

GPL, a experience and ingenuity are at work assisting the FAA Bureau of Research and Development in the creation of a modern data processing center: the heart of tomorrow's air traffic control system. The center will receive up to 400 aircraft flight plans hourly, remember 1,000 such plans simultaneously and transmit 200 plans and 200 updates hourly to adjacent centers. Automatic processing and unique displays of such data will make significant contributions to the efficient control of aircraft in enroute, terminal and terminal areas.

The FAA data processing center is just one of a number of airborne and ground-based programs utilizing GPL capabilities in the data handling field. These programs are supported by GPL's proven ability to understand the customer's problem and capacity to anticipate future requirements. The GPL organization is "systems oriented," offers complete turnkey services ranging from research, engineering and manufacturing to customer service.

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HURRICANE-PROOF "OVERCOAT" FOR THE JUPITER...



"buttoned up" by 24 Saginaw 1/2" Screws

Buttoning up the "overcoat" for the Jupiter ICBM is a job for the Saginaw 1/2" Screw. The "overcoat" is a portable prefabricated shelter designed by Morton & Rowland, Chicago, and U.S. Army Research, Development and Engineering Laboratory, Fort Belvoir, Va., to protect the missile's tail and personnel working on it. The shelter has 12 large windows with large panels raised externally to form a weather-tight seal around the Jupiter's tail.

The Saginaw 1/2" Screw controls entry matters into shelter with major efficiency. It enables the Saginaw Screws to dependably raise or lower these panels—and hold the shelter securely in place—even in the face of 74 mph hurricane winds. In fact, each Saginaw Screw is able to withstand a sustained wind load weight stress of almost five tons! The Saginaw Screw also offers substantial savings in space, power and weight which make the shelter easier to transport and assemble.

The Saginaw Screw may be able to give your product that valuable Sales Appeal you're looking for. To find out, write or telephone Saginaw Bearing Screw Division, General Precision Corporation, Saginaw, Michigan 48601, the largest producer of 1/2" screws and spacers.

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WORLD'S MOST EFFICIENT ACTUATION DEVICE



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F4H-1 STRUCTURE AGAIN PROVES *hi-shear* RIVET VERSATILITY

The Navy's next generation fighter—the McDonnell F4H-1 flies at better than twice the speed of sound, has a greater range than any Navy fighter and can operate day or night in any weather as an interceptor or an attack role.

Structurally, the F4H-1 posed a variety of critical fastener problems—high strength/weight requirements, elevated temperatures in structure adjacent to the two J79 engines and afterburners, requirements of fatigue and firing design, fatigue and vibration conditions—all met by Hi-Shear rivets, extensively used throughout the fuselage, wings and empennage.

The Hi-Shear rivet, service proven over the years in high performance aircraft and missiles, can answer similar problems for you—match the weight and installed cost of the Hi-Shear rivet with any other compatible winged fastener.

Today Hi-Shears can meet temperatures to 1200° F. are available in sizes from 1/8 inch to 1/2 inch and come in materials including 7073-T6, alloy steel, titanium, 5% chromium steel, A286 alloy along with 431, 302 and 17-4PH stainless.



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THE F4H-1C WAS DESIGNED TO BE A TWO-ENGINE FIGHTER. WHEN SUBJECTED TO 400° F. ENGINE TEMPERATURES ON THE F4H-1C, THE F4H-1C WAS DESIGNED TO BE A TWO-ENGINE FIGHTER.



dead center

Kelsey-Hayes thrust vectoring systems give missiles proper directional control.

Kelsey-Hayes is contributing substantially to the design, development and production of new thrust vector control systems for solid fuel propulsion.

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The novel nozzle control is just one of the latest developments by Kelsey-Hayes as a subcontractor of propulsion subsystems, flight components and high performance materials. Spearheading Kelsey-Hayes activities is the Advanced Design Group, a flexible team of experienced design specialists. Kelsey-Hayes Company, Detroit 37, Michigan.

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Spotlight on Nuclear Plane Program

The open congressional hearings on the civilian nuclear-powered aircraft program sponsored by the Air Force and Navy have shed considerable light on the performance, current situation and future prospects of this security, shrouded, budget-starved program. The American people owe considerable thanks to the Joint Congressional Committee on Atomic Energy and the staffs for these specific hearings. Sen. Clinton Anderson (D-N.M.) and Rep. Melvin Price (D-Ill.) for their persistence in demanding a public accounting on this program.

The most important fact to emerge from these hearings is that despite other indications to the contrary, the nuclear-powered aircraft program will be pushed at a modestly accelerated rate in the future and that, on balance, thought will be given to establishing a more effective technical direction of an overall program pushing both the General Electric Co. design as well as the Pratt & Whitney Aircraft indirect cycle approach where major technical breakthroughs have so far eluded them.

It is evident from testimony of Dr. Herbert York, Defense Department director of engineering and research, that considerably more emphasis will be placed on tractor and materials development and less emphasis on putting a flying testbed into the air to gain flight experience with nuclear powerplants.

Certainly there can be an argument with the thesis that major airports must be given to scratch on an improved airborne navigation and the airlines required to change. However, there is considerable difference of opinion on the abandonment of the construction of purpose-built airports aimed at gas flight expansion with a complete revision of this type. Dr. Yark and his scientific advisors argue that this would hardly be a useful expense in achieving the state of the art. It is apparent from their testimony that this technical viewpoint also is strongly held by the current budget problems of the Defense Department, and it is often difficult to measure where the technical considerations end and the budget cuts are begun.

Min Gen, a UNDP Korea, who has directed the UNDP program of the AID program and whose experience in developing radically new types of power goes back to the first turbopump aircraft, takes the opposite view. He believes the experience gained from being under-powered prototype aircraft with propellers that it is not technically possible to develop new, more powerful valuable experience necessary to the ultimate development of a useful weapon system. Gen Kwon must find many of the arguments advanced against the reactor prototypes very familiar as they are the same arguments advanced by many apparently competent technical experts in the nuclear and civil aviation against the application of gas turbine power to aircraft. People with sophisticated, high technical resources will still find that even such rudimentary air systems as the Nautilus' Airborne

Committee for Acoustics dismissed jet propulsion on the ground that it would hardly be useful unless aircraft speeds were over 500 mph. And such speeds were obviously not in sight. But only a few years after that judgment was rendered the German ME 262 twin jet was fighting at speeds in excess of 500 mph.

Gen. Kern went through the difficulties involved in getting USAF acceptance of jet propulsion in the early 1940s when asking the necessary determination of the late Gen. Hearn H. Arnold, overriding his technically sound subordinates, pushed the project through to successful completion with the help of Gen. Kern and others not so technically conservative.

It also was a geographic reality that the nation's core of the XB-15 and XB-19 experimental heavy bombers built at Boeing and Douglas respectively. Only one of each was ever built, and they were "too slow" to be useful for combat. Yet the experience gained by building and flying these controversial giant birds and the technical foundations for the development of the combat-capable heavy bomber lineage of B-17, B-24, B-29, B-32 and the four-engine transport birds that made U.S. strategic troop transport in this field during the post-war decade.

It is now for technical "experts" lacking the background in aircraft development problems to discuss too lightly the need for experimental flight experience as a sound foundation for efficient military developments.

There was considerable testimony, submitted by such technically competent witnesses as Gen. Thomas White, Dr. Herbert York and his staff, Vice Adm. J. T. Hayward, Gen. Keith, Roy Shultz of General Electric and John McGee, chairman of the Atomic Energy Commission who has had considerable experience both in atomic and nuclear developments. The conflicting viewpoints expressed by these gentlemen should be carefully considered in formulating a new and more suitably supported nuclear-missile introduction program.

In contrast, the notions of some newsmen to the Pentagon were should be heavily discounted as a mere parodying of the Budget Bureau's ploy.

It has been the sad history of the nuclear-powered anti-miss program that it has been the technical people who have been closest to the program, both in the military and industries, who have had the strongest faith in its ultimate success, and it has been the politically appointed Defense Department officials and the bookkeepers of the Budget Bureau who have been most pessimistic and have stepped hardest on the brakes to slow its progress.

The congressional hearings have done much to clear the secrets shrouded in this vital program. We hope that USAF, the Navy and Atomic Energy Commission will join with General Electric, Pratt & Whitney Aircraft and industrial contractors to formulate a technically rigorous program to drive ahead with new means used to conduct militarily useful tests.

Robert Hertz



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Lawsuits Hit Avionics Ex-Employees

Washington—A rash of lawsuits filed here last fall in aviation manufacture recently against former employees who have established new firms to compete with their former employers. Majority of the aviation market semiconductor division where the original employer charges loss of secret techniques and know-how.

- **Sperry Rand Corp.** has filed suit in Federal Court for \$1 million damages against eight former employees of its Semiconductor Division who recently left to form National Semiconductor Corp., Danvers, Conn. Suit charges defendants with unlawfully removing certain secret documents, misusing proprietary information.
- **Fairchild Semiconductor Corp.** has

filed a \$1 million suit against Robert Semiconductors Corp. of Vancouver, Wash., and its California Semiconductor Division. It also filed suit for \$100,000 in damages from Dr. J. M. Roberts, vice president and general manager of its research branch Microelectronics. Dr. Roberts formerly was vice president and general manager of Fairchild Semiconductor Corp. Eight other former Fairchild employees now with Roberts also are named in the suit. The suit charges the defendants with appropriating confidential information in the working time of semiconductors division of Fairchild Semiconductor and that it was found around a pattern of activities which left Roberts' testimony. (Shackles, Baltimore)

• **Melpac, Inc.**, division of Westinghouse Air Brake Co. has brought a \$500,000 suit against two former employees and a security bonded company, Scope Inc. charging misappropriation of proprietary secrets, data and information. Two Melpac employees, Richard T. Williams and Jonathan J. Bosman, are also objects of Scope Inc. Another 20 Scope employees formerly worked at Melpac company since.

Within the past few months there have been a number of similar actions—

- **Electronic Tool Corp.** filed suit for \$737,000 against two former officers, 17 former employees and three firms charging them with using secret processes developed by their former employer who manufactured ship engine instrumentation and electronic components.
- **Series-Turner, Inc.** lost a \$2 million suit against Audio Design Inc. and others charged with piracy of secret processes for making of sonar receivers. In ruling against the plaintiff, the court held that the methods employed by the defendants were well known in the industry and that the plaintiff had failed to state any specific trade secrets involved.

Martin Co., Thiokol Report Higher Sales

Two major defense contractors—Thiokol Co. and Thiokol Chemical Corp.—reported substantial sales increases in financial reports made to stockholders last week.

Martin Co. second quarter sales rose \$5,956,515 over a similar period a year ago for a total of \$125,895,629. Income earned on the sales totaled \$5,177,066, or \$17.46¢ more than the second quarter of 1955.

Thiokol Chemical reported its recent sales of \$50,713,932, up \$28,477,561 over that period last year. Net income rose \$2,965,569, or increase of 211% in the first quarter of 1956.

• **Ammopac Corp.** earned \$2,801,877 in the first quarter ended June 30, 1956, over last year's same quarterly earnings of \$691,435. Net sales aggregated \$15,940,056, up 10%.

• **R. F. Goodrich Co.** sales and its 77-day drive in eight consecutive higher plants, increased to \$15,360,949 for the first half of 1956, a 34.9% increase over the \$11,379,349 recorded in that period last year. Net income was \$1,612,480 compared with \$14,907,241 a year ago.

• **The Grubbs Co.**, which plans to build a solid rocket plant at Middletown, a new electronics plant at Middletown, and first test plant at Middletown, Md., announced that sales of \$14,574,456 in the first half of 1956, up 10% over last year's \$13,215,000, against \$123,170 reported last year.

Missile Test Failures Explained to Congress

Washington—Operational schedules for the Air Force-Corpus Alfa and the Navy-Lockheed Polaris test vehicles are not expected to be affected by the recent series of flight test failures the House Science and Astronautics Committee was told last week.

Dr. Glen Bernard A. Seiber, vice member of the Air Research and Development Committee, and the target date for the first operational Alfa has been set back at least 60 days because of flight test malfunctions, but that the Air Force can adhere very closely to the overall operational first building schedule.

Rep. Allen W. F. Roberts, director of the Navy Special Projects Office, even more emphatically regarding the development of the Polaris. He told the Navy at meeting its most recent accelerated schedule of target dates and can conduct its studies there will be operational Polaris submarines with missiles available for deployment by the end of next year.

Both Gen. Seiber and Allen Roberts were called before the House committee to explain the causes of five aborted Alfa shots and the failure of a Polaris test vehicle (AW July 20, p. 25).

Gen. Seiber said the recent failures of Alfa C and D series missiles were all of the type and severity which must be expected in any advanced and far reaching development program. "While we have had our troubles in the past and must expect more in the future," he said, "I believe this country has an ample Alfa program regarding the current status of the Alfa program."

Allen Roberts told the committee that recent or failure of individual test vehicles might be general tests which be measured in terms of contribution toward ultimate goals and that some untested failures have contributed much in this respect.

"Of the 13 test vehicles of test vehicles," he said, "25, or slightly better than two out of three, were completely successful in that all specific technical objectives were accomplished. Six of the 13 were noted partial success in that one or more of the previous technical objectives were achieved, and no launchings were failures where none of the previous objectives were achieved."

Allen Roberts said the July 15 test, which is the current objective might be considered a failure, but is relatively "strategically successful" from the point of view of getting a successful launch.

One of the primary purposes of the flight was to test the vehicle launch, he



Vought Displays Project Scout Model

Scale model of Scout high altitude research vehicle and launchers has been built by Chance Vought Aircraft, Inc., which is building the 70-ft. model for National Aeronautics and Space Administration. Scout will be used to test new probes and low orbital and re-entry research. First prototype tests are scheduled for late 1956 at Wallops Island, Va. Four-stage, solid propellant vehicle will weigh a 100-lb. submunition package 7,000 mi. at nose and will place a 150 lb. payload in a nominal 300 mi. orbit.

and "Although the test vehicle went into unexpected scenarios, the missile has performed beautifully given under most vigorous conditions."

He added that the magnitude and the performance of the missile tests in this test were so outstanding that the Navy is considering shortening the phase of the development program. Cause of the accidents, Roberts said

was loss of a part of a jet engine (AW July 27, p. 25) which was occurred and is now undergoing intensive investigation and other tests as a base for developing inspection procedures to prevent a recurrence.

Allen Roberts also told the committee that the Navy plans on firing the first prototype 1956 operational Polaris missile into the sea.



Hughes Falcon GAR-3 in Production

New Hughes Falcon GAR-3 takes housing model, powered by a Thiokol solid propellant rocket engine, is reported by Rep. E. Wyandell Hall, Hughes Aircraft vice president and Tom J. Smith, company test pilot. "There was some trouble," Lyons 5 to 10, about drive, in speed and temperature measurements. Effective changes include rocket length, increased wingspan and extension of stabilizers. Missile is produced by 37 S. Air Force.

Intelligence gathering system for the Coast Guard's space vehicle will be developed and produced by Minneapolis Honeywell Regulator Co. under a \$5 million contract from Canada Division of General Dynamics Corp. Contractor will be a pure satellite system and a variant of Honeywell's automatic integrating gyro matrix guidance system, according to M. P. Fellers, vice president and general manager of Honeywell's Automatic Division at St. Petersburg, Fla., where the work will be done. Contract was awarded by the first U.S. liquid fuel drugless rocket engine test, involving component testing of D-200 Test Bench, Inc. (AVI, July 28, p. 28).

New Delhi—Indian Railways Ministry has signed a license agreement with Hawker Siddeley Group for modernization of the Aero 748 turboprop transport at Kanpur. The aircraft will be in 1991.

Kanpur Tychemat Co., owned by Indian Airlines, now is manufacturing nose and gear. Hawker Siddeley will provide fuselages and aid in engine testing problems. The aircraft, now used by two Delhi-Bombay, Delhi-Delhi-Chennai, will replace Douglas C-47 transports now in use by the air force.

Delfino, Germano—Murillo, SM 67, a tall, fit, stout, friendly, strong, and bright, built by Murillo, K. G., has made his first flight powered by a Volkswagen Jetta. 28 yrs. father, cigar, who is 790 cigs.

Washington-United Kingdom agreed last week to provide several military instruments by British scientists for launches over the next three to four years with National Aeronautics and Space Administration's low-cost solid-propellant Scout vehicle. U.S.-U.K. discussions for a joint program began last month. Scout will be able to put a 1500-kg payload into a 300-mi high orbit.

Ames, Calif.—Acme Corp. of Cypress has donated \$400,000 to California Institute of Technology at Pasadena for the purchase of a new research laboratory, which will be named in honor of Dr. Theodore von Kármán, internationally known aviator and scientist. The laboratory will be devoted principally to the study of jet propulsion, thrust vectoring and load alleviation.

Dr. von Kármán directed Caltech's Guggenheim Aeronautical Laboratory for more than 20 years and was one of the founders of the Aeronautical Engineering Group in the late 1930s.

Four American World Airways jet took off on 12 January 41, 307 Super Hercules on flight for almost in 1962. Four American will visit Diego IX "C" to train on the system for use with the Lockheed helicopters to be delivered. The 502nd has four American orders for the Super Hercules follows a Black Hawk in the

Engineering Inc. (Riverside, Calif.) in 1992, but four months since management last week asked where Stines will be merged into, it now admits under 100 local employees. It just didn't say for the months which still must be approved by Stines shareholders in a Sept. 28 vote. Under the agreement the agreement will 100 shareholders of the company will seem to have no real ball because shares the rich Stines have. New shareholders will allow the Stines own to continue, work under the present Stines management at Pichman's discretion for the agreement to be signed, but also

Systems Division has been awarded its 1984 contract and, along with a new program and the offer to a spin program. Thus, in the first month, the division has secured what it began its original studies as an independent unit.

under stainless steel Inconel patch for the B-7D fuselage, systems that Lockheed Aircraft Corp. will build as a sub-

General Aircraft has completed design of a 100-ft equivalent bridge stress test facility for use in development of bridge truss members, girders and truss subassemblies, joints, nodes and

Chrysler Weekend Airmail sales for the first half of 1999 totaled \$332,929,134 a drop of \$21,309,812 from a similar period a year ago. Reasons for the six-month period were \$5,097,786 in discounts of \$1,600,440 from a year ago. Drop resulted from termination of Chrysler III jet fighter and Republic II missile programs for December. Profit under license to \$300 million is compared to \$542 million as of June, 30, 1995.

Automotive Laboratory. Its research into development of nuclear energy systems will be built at the Pittsburgh, Pa. site by Westinghouse Electric Corp. Unit will be part of a new Atomic Power Division headed by John M. Simpson, vice president. Dr. Nelson Kravik will be laboratory director.

Reaction Motor Division of United Chemical Corp. has been awarded a \$1.5 million contract by U. S. Navy for production of Carboron II paper, used in rocket engines for use in the Navy Taurus Cruise Jetto-motors, see ENR, July 27, p. 27. Engage will

New York—Modification: 120 probably will result in a Pas American World War which, American Winter. A record of timber: fair

On July 7, according to the *Wall Street Journal*, the same airplane came out from Boston after a couple of the tankers' arrivals, and subsequently landed on the tarmac at New York by the New York Authority.

The leading gear in determining possible timing of the move through current, could probably assist a seduction or a highly specific in the, inevitably a union change in long order and adjust the timing nature so that the which also takes off will be slightly more slow and a half size of which.

as unscheduled landing at
when the gas situation is
stopped by an automatic cutoff
can also contribute to a low

The Clean Company

A record of fault failures on the plane revolved as the accident proceeded the emergency, and has resulted in a federal FAA charge against Pan American of violating maintenance procedures in connection with the post-Cold Air accidents Board, in a New York hearing on the incident, was informed last week that the passing and failure of the landing gear track beam closely followed a record of similar failures and operation by Pan American without a member FAA procedures before the accident prohibited operations without the main beam.

In a report for the GAO's Bureau of Air Safety, aeronautical design engineer Benjamin W. Lusk, who designed the airplane, is questioned over operations from Santa Monica, Calif., Lusk said, a similar, on July 19, which was one day before the failure of the track beam.

The employees of NTPA was housed at July 9 to have danced outside hotels, and the hotels were replaced with campsites according to the report. The employee was then taken to Santa Ana, where employees showed them that the employees of the hotel were not allowed to enter the hotel. The hotel was removed and the employees from New York, among other than among the number. The seven employees were in a meeting at the hotel on July 9.

Boeing has been tight testing the gas turbine cycle; it has been found that problems will be corrected these before the operators in the new fleet.

Confidential Airforce recently made its scheduled landing at Chicago when the gas situation was not so good. The gas situation was not so good. The gas situation was not so good.

As of last week, this was the status of each airline as far as the models:

- Pam American has installed the bypass seat in all six of its jets, and was well along with the filter installation
- Trans World Airlines had previously reduced the new type of pump but is installing the bypass system, on all 17 of its jets pending delivery of the new pumps

In connection with the crowd problem that bedeviled the Pan-African congresses, IAA last week met with the National Association of Broadcasters, which volunteered to ask its members to urge the public to stay away from an airport when an emergency situation exists. Such admonitions would be included in radio and television an-

Pan American denied a report that its officials had attributed the alleged conspiring of minor incidents to the jet crash, between the British and Americans. But PanAm has added that it is, consulted by the airport operator before a major emergency or disaster.



Boeing 707 Marks Fifth Anniversary

Three World Airlines Boeing 707-120B, trailing dark smoke caused by water ingestion, takes off from Chicago's O'Hare International Airport, celebrating the fifth anniversary of the first flight of the jet transport. Prototype 707 first flew July 15, 1958, with a V-1 (Test) Jetstream, Boeing chief of flight test at the controls.

ALPA Attacks Pilot Age Limits; Threatens Economic Pressures

Washington—Air Line Pilots Assn. renewed U. S. airline pilots' protest last week that airlines age limits for pilots proposed by the Federal Aviation Agency will curtail a limited transition program for the career without impacting the level of air safety.

Action by the pilots' union in the form of a letter from ALPA President C. N. Sacco, followed closely on the heels of an ALPA request that FAA release to the union all data upon which the agency bases its proposal to phase out pilots at age 60 while strengthening jet training to those below the age of 55 (AWT July 6, p. 10). At the same time, ALPA urged the agency for an immediate hearing on the proposed rule change.

FAA spokesmen say the agency will not grant ALPA's requests and has no plans for a hearing until after Aug. 18, the proposed deadline for arriving comments on the proposed change from all interested parties. "We are not willing to study the comments

Requesting the same objectives lodged with the FAA, Sacco told the airlines that pilots' union agrees a proposal had tended to curtail the program, that it takes career air experience that aircraft with pilots, but did to perform competently or meet planned standards.

"This is of course a suit scenario, since both the union and the federal government have committed as to the physical fitness and competence of all pilots now in service," Sacco said. "We think it would be unfortunate if the processing of this proposal would result in such a public spectacle as to undermine public confidence in air transportation."

Continuing that existing regulations already provide compulsory retirement for a pilot who cannot meet current standards "whether this occurs at 50, 55, 60 or 65," Sacco said, FAA's proposal would be "an arbitrary, and unjustified, no distinction between competitors and incompetency or state

of health, but proposed that a person's health and competency immediately link to exact standards of some age pulled out of a hat. This is not just to be said."

Turning the proposal "essentially an industrial relations matter under the Railway Labor Act," Sacco said, its adoption would have a "detrimental and avoidable economic effect" upon the entire airline industry. He estimated that more pilots, particularly on airlines desiring to reduce personnel aircraft weight, would be forced to leave the industry at a rate of \$250,000 as the result of this proposal.

"Adoption of the proposal 'further'," he said, "would have the effect of altering the contractual relationship between the union and the airlines, and the pilots would have an alternative but to cause the association to immediately serve within under the Railway Labor Act of intent to restore the earnings potential within the shorter career."

Sacco told the airlines that, while safety problems are in flight transportation do exist, they are not those related particularly to age, but are of the type that happen to all persons in the industry process of living, against which the

FAA proposal would provide no protection.

The only schedule protection against such accidents, he said, is the positive protection provided by the "test and select" concept requiring pilot quality features for all crew members long trained by ALPA and much official pilots in the union in 1956 for the question of jet aircraft. The pilots' union earlier passed a June 25 proposal of FAA which would require explicit to be fully qualified and checked periodically on the aircraft in which they are assigned.

Differences in Proposals

Major differences between the FAA's age proposal and ALPA's "test and select" concept and Sacco in the difference between an "industrial program," as proposed by FAA, that would require pilots, but a change and for reaching economic effect and not attain the desired objective, and an effective program proposed by the association that would provide positive protection without the other undesirable consequences.

Age, his H&H, bearing on the problem of flight safety, ALPA concludes, shows 57 Civil Aeronautics Board aircraft accident reports from 1946 to June 1, 1958. In these concerned 68 jet accidents and the union 27 were attributed to the CAB to the continuing age pilot. One captain was in his 70s, 16 were in their 60s, nine were in their 40s and the oldest was 51, ALPA said, while only two fatal error accidents involving captain-pilots, 50 years of age or older, have been reported by CAB since 1946.

No accident has been attributed to other age or physical breakdowns of the pilot, the union added.

Transition to jet aircraft also has failed to disclose any pattern of pilot age, and check-out times have been less than anticipated for career with simulator and real physical training programs, the Air Line Pilots Assn. stated.

USAF Training Cited

As an example, ALPA pointed to the U. S. Air Force transition training for the B-47 which, the union said, requires 100 hr of ground school and 40 hr of simulator flight time, while the commercial airline pilot check-out time for jet is about 160 hr of ground school and 10 to 20 hr of flight training.

New Revenue Gains Reported by Northwest

Washington—Addition of the Florida market to Northwest Coast Airlines' route system combined with significant traffic gains over the balance of its revenue gave the carrier a net income of \$1,836,119 for the first six months of the year, a gain of 240.5% over the same period of last year.

At the same time, Eastern Air Lines reported a 26.2% decrease in net income after taxes for the last half of the year which produced a profit of \$3,647,640 as compared with \$1,042,730 for the same period of 1958. Spokesmen for the airline attribute much of the decrease to loss of inter change service with Northwest out of Chicago, added competition in the

Florida market area and a strike, late last year, by mechanics and flight engineering.

United Air Lines has reported net earnings totaling \$3,699,082 for the combined first and second quarters of this year as compared with \$4,190,514 for the first half of 1958.

Northwest's operating income, before taxes and interest expense, totaled \$4,843,172 for the last six months to register a 239.5% gain over the figure recorded for the same period of last year. Operating revenues of \$99,375,756 were 34.6% above those listed for the first six months of 1958, while total expenses of \$55,407,541 were 25% above those reported for the first half of 1958.

Eastern's total operating revenues of \$147,162,201 were 4.75% above those experienced during the last six months of last year, while the carrier's total operating expenses increased 5.7% to \$197,201,829 for the first half of 1959 as compared with \$192,583,416 for the same period of 1958. The airline's earnings for the period were equivalent to \$1.17 per share as compared with \$1.68 for the last six months of 1958.

United reported operating revenues totaling \$166,428,906 for the six months period, reflecting a 12% gain over the total for the first half of last year, while operating expenses increased 3% to \$192,118,275 for the half year of 1959 as compared to \$178,358,258 for the same period of last year.

Net earnings of the carrier also included a gain of \$470,800 in the sale of assets.



First Delta Air Lines Douglas DC-8

First Delta Douglas DC-8 jet transports ordered by Delta Air Lines is shown in the main's markings at Long Beach, Calif. Another DC-8, first of its kind by Trans-Canada Air Lines, has made its first flight in the state of an extensive test program before delivery. The Trans-Canada aircraft was scheduled to reach four hours, piloted by W. H. R. Fairman, Douglas test pilot.

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SHORTLINES

► **Bonanza Air Lines** reports that it flew 19,000 passengers a total of 4,734,000 revenue passenger miles during June. Passenger miles increased 99% over June, 1958.

► **Eastern Air Lines** was scheduled to begin Lockheed Electra turboprop service on its New York-Jacksonville-Palm Beach route late last week. Southbound flight 607 leaves Newark Airport at 9:30 a.m., arrives Jacksonville-Tanaka Municipal Airport at 11:17 a.m. and Palm Beach International Airport at 12:42 p.m. Northbound flight 608 leaves Palm Beach at 7:10 p.m., arrives Jacksonville at 8:40 p.m. and Newark at 8:55 p.m. All times are local.

► **Flying Tiger Line** reports a 25.7% gain in flight traffic during the first six months of 1959 over that of last year. The carrier posted revenues of \$5,653,800, as compared with \$5,276,167 for the first half of 1958. Few month's revenues were up 39.1% over June, 1958, at \$1,262,749.

► **Herz Air Lines of Spain** will add a second Lockheed Super Constellation flight to its weekly Madrid-Mexico City route on Aug. 11. The flight is routed from Madrid to Santa Monica, Azores, Bermuda, Havana and Mexico City.

► **Icelandic Airlines'** continued flight schedule a 10% passenger gain during the first six months of this year, as compared with the first half of 1958. The carrier's load factor for June was reported at 96%. The airline reported a 190% load factor for June, 1958, as compared to schedules in 1957. For June 1959, its summer schedule IAL now offers nine weekly flights to Europe, including two weekly services to America direct and London-Los Angeles.

► **Philadelphia** has asked for bids for construction of a \$2.5 million addition to Philadelphia International Airport's terminal building. The addition, which will expand the terminal building to 379,000 sq. ft., the largest reconstruction planned to date for the seven old structure. The federal government will pay 51 million of the cost. The airport handled 1.6 million passengers in 1958, and city officials predict that some 2.8 million persons will use the field in 1963.

► **Trans World Airlines** has appointed Japan Airlines as its general agent in Singapore and the Republic Trading Co. as its general agent in Korea in the Pacific East area.

AIRLINE OBSERVER

► Early observation of propeller-driven aircraft including turboprops, in case of future developments in the field of turboprop engines now produced in American Airlines' factories in the Southern Transportation Service Co. American Vice President William Littlewood said he believes "that turboprop-driven aircraft, even including modern turboprops such as the Lockheed Electra, are being actively studied by developments in this modified low engine type, and that this state of observation will accelerate from here on."

► Argentine government may outline in order for 15 Fairchild B-27 turboprop transports for use by Aerolineas Argentinas. Then for the \$12 million order received for a tug which Minister of Transportation Abrego says he would be willing to approve the purchase on grounds that the airline was not self-sustaining. Fairchild spokesman says that Abrego has now indicated that the government economic council has decided to reject the transaction within the next six weeks.

► **British Overseas Airways Corp.** plans to resume service to South America next Jan. 25 using de Havilland Comet 4 jet aircraft. Service was suspended in 1954 after earlier Comet models were withdrawn following two Mosley bomber accidents and will be resumed with two weekly flights in each direction between London and Santiago, Chile, via Miami, London, Dallas, Recife, Rio de Janeiro, Montevideo and Buenos Aires. BOAC also plans to begin Comet 4 service between the East and Europe sometime this month. The jets are scheduled to fly between Hong Kong and London at 22 hr flight time, seven hours less than the fastest current flights.

► **United Air Lines** ("united") will fly seven more Boeing 720 medium range jets prior to next April for 1962 deliveries, according to President W. A. Patterson. Both first class and coach configurations will be provided on United's jet service, with the increased order bringing the airline's jet fleet to 65 aircraft, he said. The company already has purchased 40 Douglas DC-8s and 16 Model 720s from Boeing and is moving more than 500 million in training flight and ground personnel for jet transport operations.

► **Government Belgium** and the **United Arab Republic** have signed a bilateral agreement in Cairo to establish aerial commercial service.

► **Trans World Airlines** is sending one of its Boeing 707 jet transports to Moscow to transport the press delegation covering the Soviet visit of Vice President Richard Nixon to Poland and return to New York. TWA 707 will be its public display for two days at Moscow's Vnukovo Airport and is expected to take Aeroflot and Soviet aviation officials to the airport. TWA will make one stop at Kishinev, Rumania, on its Moscow-Vnukovo route. Aircraft is expected to arrive in Washington on Wednesday.

► **United Nations Agency** has ordered a survey made of the use of some 200 million restricted areas to provide for mass aircraft use of all age and size to create safety of the aircraft. Survey will cover the period from Feb. 1, 1958, to June 30, 1959, and is being conducted under a special TWA agency regulation which became effective last week, requiring certification of designated restricted areas to submit a report within 30 days of the use made of the areas during the one-year period.

► **Japan Air Lines** is planning plans to acquire a short around-the-world route from Tokyo to London and New York via Siberia and Moscow, but has not completed agreements with the Soviet Union. Meanwhile, Japanese government officials are reported studying a plan to gain entry into Moscow via chartered Russian airlines, such as the Tu-104 suggested by Russian crews.

► **Bonanza Air Lines** last week announced orders for four additional Fairchild F-27s in the first final order under the airline's first purchase. Under a Civil Aeronautics Board granted lease agreement June 15, 1958, the carrier purchased six F-27s at a cost of \$48 million. Three of the aircraft have been in service since March, and the airline will take delivery of the remaining three in September and October of this year. The new models ordered for 1960 delivery, are powered by Rolls-Royce Dart engines.

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In 14 key areas throughout the U. S., there is now a complete Holley service shop readily accessible to airlines flying the Boeing 707 or Douglas DC-8. These service outlets are fully equipped and stocked branches or main service departments of three well-known aviation parts and service distributors: Pacific Airservice, Southwest Airservice, and Airwork.

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safety equipment for the West Coast's first ball-borne-missile base. From two tracking sites at Vandenberg Air Force Base, like two searchlights with their beams intersecting on the missile, Bi-COTAR drives detection information from standard telemetry signals. At the Instrument Control Center precise trajectories and predicted impact points are plotted for the Range Safety Officer. . . in grade to discuss

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SPACE TECHNOLOGY



BERYLLIUM extrusion billets (left) are 31 in. in diameter and are made for Nuclear Metals, Inc., by Brook River Iron Co. for use in extra size experiments. At right a hot beryllium billet is being processed after rolling through powder glass lubricant.

Tests Aim at Beryllium Use in Spacecraft

By Richard Sweezy

Hereafter, Cubic-Sagecraft will share in the progress to develop beryllium for aircraft and space vehicles, as has been reached with the accomplishment of large extrusions of the metal into conventional structural shapes of "aircraft quality," in lengths up to 15 ft.

Nuclear Division of Nuclear Metals Corporation of the program to develop beryllium extrusions, has been working on the proper processing techniques for aircraft type extrusions of beryllium. Finishing the project is J. Van Housen.

Working under contract no. AF-17-6087-50951 from the Air Material Command, Aeronautical Systems Center, NASA is having the initial extrusions performed at the plant of Nuclear Metals, Inc., Concord, Mass. Beryllium is being supplied by the Brook River Iron Co.

Metals Sensitivity

Biggest problem with beryllium, according to Van Housen, is its metal's extreme notch sensitivity. First attempts to extrude the hard material resulted in considerable cracking, galling, and serious after metal deformation, commonly called "workhardening."

Van Housen, who gained considerable experience with new metals in the titanium development program, worked along the same general lines which had been followed in that effort, to arrive at development of techniques required to extrude the beryllium.

Although not yet extruded to a full 20 ft. which is the target length for sections, Van Housen says that currently satisfactory extrusion of

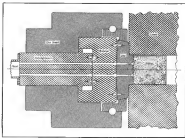
U-shaped extrusions has been accomplished in lengths up to 15 ft., with all indications being that the 20 ft. length will present no problem within a few weeks.

With the advantages of its strength/weight ratio at elevated temperatures, beryllium is expected to make an excellent aircraft-type vehicle structural material. Backing this, since most of the development work at obtaining the proper process to effectively extrude beryllium, the shapes which are most commonly used in aircraft work outside of sheet, i.e. channels, T-sections, Z- and U-shaped sections.

The first efforts were directed toward the U-shaped, since the majority of other structural shapes are taken from this. Work presently being done is three instead powdered billets being made in Brook River Iron. These are, approximately, 54 in. in diameter and 11 to 12 in. long.

Cost factors

However, efforts also are being made to beryllium work at Brook River Co. at America to develop a cast ingot from which to work, and it is hoped that the two programs will dovetail later on, so the post effort will produce cast beryllium.



INTERNAL arrangement of a Nuclear Metals press die shows distribution of components.



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boom angles or deflections which will be suitable for the extending process.

Early in its business work, Norton secured 10 sample aircraft firms, and their replies indicated that 75% would be no large quantities of beryllium within the near future; that is five years or less. This value of the material at about \$30 to \$250 per lb. is the cost they were willing to pay.

In the space vehicle applications, cost was estimated for the cost of a pound of weight either put into orbit or sent into space run to approximately \$35,000. Since the substitution of beryllium for steel at approximately the same density or magnesium would achieve weight reduction at least in this order, the cost of \$30,000 for a maximum figure of \$270 for the material alone, illustrates the significance of the material in this application.

One of the biggest problems in creating the material has been development of a proper die shape, material, and the lubricant required. In addition, proper temperature, and time pressure also play a significant part in the extending process. Throughout the effort, Norton has continually varied these elements seeking the best combination possible for the best extending process.

Currently the best techniques have led to these parameters:

- Use of glass in the lubricating spot
- Use of a billet 14 in. in diameter, 18-22 in. long
- Temperature of 1,900-1,950°C. Experiments have ranged through 1,675 to 2,000°C.
- Use of graphite as the die material
- Rate speed of approximately 0 to 35 in. per second (Extension rates of up to 50 in. per sec.)
- Rate pressure approximately 1,700 tons (Clamping has been 1,475 tons to 1,700 tons)



Copper Nose Cones Formed by Closed-Die Forging

Copper nose cones for Atlas intercontinental range and Thor intermediate range ballistic missiles have been forged by Waco-Gordon Co. in a single pass on a 90,000-lb. pressure die-casting lathe inside press. Cones are 5 ft. in diameter, 2 ft. deep and 12 in. thick. Shape is made from copper billets. Copper's ductility without sacrifice in ultimate properties permits a slight 1/2-in. diameter to cone for taper.

- Extension ratio of 25 to 1. (This has varied from 20 to 1 to 60 to 1.)

The beryllium extension coefficient now which has been sought only for a channel 1.5 in. outside major length, a maximum channel depth, a wall thickness both tapered and increased of 220 in. with center ratio which is 175 in.

Straightness weight rate 0.0175 in. per foot of length, a heat (each use) use

half degree per foot of length. 5 deg total maximum sagittal. (Less than 0.155 in. thick), plus an extra 25 in. of any point of maximum length plus or minus 25 in. flanges to the maximum dimension of 0.084 in. per inch a surface roughness of 100 maximum grain, and a target length of 20 ft. or less.

Material composition requirements for direct extension work only for the



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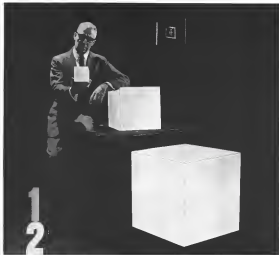
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2
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A production line unit of ARMA's newest model has operated in excess of 4000 hours without a component replacement. And the 1960 and 1962 versions will have reliability factors at least equal to this.

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following elements and percentages: carbon, 0.15% maximum; iron, 500 parts per million maximum; 1,800 parts per million maximum; tin, 100 parts per million maximum; 0.05% maximum; copper, 0.05% maximum; aluminum, 0.15% maximum; manganese, 0.01% maximum; phosphorus, 0.10% maximum; silicon, 0.05% maximum; magnesium, 0.01% maximum; berillium oxide, 1.50% maximum; and berillium the remainder.

One of the problems facing berillium is its toxicity. However, this has not proved to be a hind at expected, according to Van Housenfeld. Carcath, he says, the structure is "Berillium introduced into the bearing surface will prove safe. However, if normal precautions against dust emission and inhalation are observed, working with the metal is perfectly safe in these respects."

During the extrusion process, workers wear a rubber respirator mask, of the type commonly worn in spray painting berillium. For operations such as drilling and cutting, the work is kept hooded and an air vacuum system is used to draw the dust into a high quality filter. Present practice is either to take the dust directly to a vacuum during the filtering process and either return it to the processing cycle for solution or release it into the air to be drawn outside to a sealed container into the seas.

Experiments up to now, he pointed out, according to Van Housenfeld, indicate that berillium can be worked in a number of ways. Following the forming processes, the material is allowed to anneal to ease temperature. The material can be maintained at room temperature. It can be drilled in an ordinary fashion, using the proper hardness of tool steel for the drill, the proper feed rates, and the finish which results

is completely acceptable. Threads can be machined out into berillium and a hot roll threading process also can be used. In addition, hot forging of soft berillium can be accomplished, using a high frequency induction heating system of the same type which was used in titanium, with the temperature and pressure adjusted for berillium. In addition, electrical discharge drilling has been accomplished which produces acceptable tolerances and finishes on the berillium.

Most recent developments in the extruding process, according to Van Housenfeld, have resulted in solving the length pressure problem, and a change has been made in the glass lubricant which is applied before extruding.

'Lead-in' Material

Technique currently is that after the billet has been heated to the proper temperature, it is rolled in a glass slurry pan to bring forced through the die. Currently the process used entails a "lead-in" material such as lead or copper, being fed into the extruding die just ahead of the berillium, producing a constant pace, to effectively help the berillium in the difficult initial stages of the forming process. Also, there has been another material between the glass and the die face to start with.

However, a new glass composition has been used, which more closely matches the temperature characteristics of the billet and has resulted, in combination with the present problem solution, in sending billes through the extrusion press with the glass material only. Further simplifying the overall process.

Latest developments have led to drawing through a billet which comes out approximately a 17-ft. extrusion of

average quality with only the residue of the glass lubricant to be removed by a cleaning process.

At one time, berillium was extruded in one "end" in the reverse, a material was wrapped around the billet and soaked, the billet at temperature in the casting was then forced through the die, and after this the casting material on one was scraped off as otherwise removed from the finished shape.

Cost of this however was prohibitive, indicating need for the new extrusion process.

The variable press berillium extrusion being used has a hexagonal grain structure. One of the most severe conditions is to obtain a proper grain orientation in the material following the extruding process. The extruding process itself obtains a proper orientation in the longitudinal direction, however, it is with the transverse grain orientation. Current thinking, Van Housenfeld says, is that the material may be "annealed" (the term is as yet being in the billet from one a deep press is different and planes to control the grain orientation in the final extruded section. During the loading process in all planes, it is hoped to obtain a grain orientation which will effectively increase the mechanical properties of the material in the transverse plane of a structural shape.

In appearance, berillium is a dull grey color. Due to its granular structure, it has a fine dull sheen. In a heated shape of 200 inch, the material is not toxic and it can be handled without gloves, can be handled can be handled in any ordinary manner.

It is comparable in nature with most other metal materials, that is, it can be used in combination with them in structures without resulting in galvanic

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interaction between the two materials.

At the present time, it is being used in its "pure" state, generally because of the cost of the material in its alloy form. It is approximately as expensive as an alloy type stainless steel. However, the material does react with magnesium. To overcome this, either a coating of copper metal or a zinc chromate primer compound would be used between the two surfaces or at least as other factors arise.

With other materials, beryllium presents no corrosion or fatigue problems. Whether these will be any change in these, as in its future properties after efforts are developed, remains to be seen. Currently, experimentation has been conducted with tests showing using metal and other beryllium metal at 3-575F.

Program Goal

Goal of the original program was to produce extruded sheet shapes because the specimens had an ultimate tensile strength approximately 65,000 psi. However, work so far has produced materials with an ultimate tensile strength of 58,000 psi. Modules of length of the material has been run up to the order of 48 in 41 collars per in. compared with a modulus of 10 million for steel.

Another problem encountered in beryllium development program has been finding proper methods for testing the material. Notch sensitivity of the material must be considered in setting up test criteria.

Currently the goal is to produce tests which accurately reflect material capabilities in order to derive the maximum values in the mechanical properties. Also, these absolute values are direct comparisons will be applied



Beryllium Heat Sink Shield for Mercury Capsule

Dish-shaped beryllium shield about 60 in. in diameter, has been successfully tested by Allt Systems Co. of Astoria from large ball supplied by Brush Beryllium Co. in one of a series of heat sink forgings for Project Mercury control space capsule. Shield, which is the second work guide, top half of the entry bottom half to press ball.

With the strength values which are available in structural shapes, that is, with the assurance of design allowable stresses. However, before the design allowable can be obtained, very accurate values of ultimate and yield strength must be obtained.

Due to the notch sensitivity of the material, it must probably will be compensated for in the design of structures using this material, (such as 735 diam

and often, which also is notch sensitive). It may be noted that in the means allow, although these are means, which follow after 735, this material still is the one and not frequently to structures carrying tension loads such as the fuselage and members of wings of jet or jet fighters. However, the superior compressive strength of the other alloys is used in wing upper surfaces and similar compressions loaded



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The unique capabilities of Dow's Bay City, Michigan, foundry help make of magnesium sand and permanent mold castings. Available in this facility—largest and best equipped of its kind—runs the gamut from large volume production jobs to one-time "specials".

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Newest techniques. Many milestones in magnesium casting have been reached at this Dow foundry. In fact Bay City has been permanently assigned to development work, keeping the foundry at the forefront of technological advances at all times.

Results of their work include special processes for cast-in inserts and tubular passages, and improved melting techniques. Casting methods have been developed for many of the newer magnesium alloys, such as the elevated

temperature group and the new high damping capacity alloy, K1A.

Quality control. A full size quality control room extensively checks all work, from alloy composition to the shipping dock. A dual-loading spectrometer makes rapid alloy composition analysis. In regard to particularly valuable when alloying elements that are hard to build in the molten state, such as thorium, are present. Chemical analysis is also frequently employed. Testing facilities. Molding and sand cores are analyzed as a regular part of casting quality control. Radiography, fluorescent penetrant inspection and other testing facilities are used to check properties and specifications.

Experienced magnesium team. The foundry often draws upon the broad range of specialized experience available throughout the company. To Bay City customers, this means assistance at high quality work, close work with efficiency and economy. If your requirements involve magnesium castings, Dow can help you arrive at optimum casting design and reliably supply your production requirements.



WE BUILT CAST NUTS OVER 1000 lbs. in size. The finished product is shown in the foreground. The finished product is shown in the background.



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With over 100 years of experience, Dow Chemical Company is the world's largest producer of magnesium. We can help you with all your magnesium casting needs. Contact us today.

structures. The same condition may also apply to hardware.

At present, finish studies are being conducted longitudinally and in cross-section. Test specimens of the same material. Later on, testing will be accomplished in fatigue, compression and shear.

Practice now is to X-ray the test specimen and then X-ray inspect for surface imperfections. Test coupons are soaked out of the test section and the surface is etched to obtain the desired finish before the testing is accomplished.

The bench development program at Norair is divided into several phases of which the perfection of the test is the most critical in the first phase. Later on, several phases down, the studies will cover fabrication and testing of various structural components under types of loading sustained under pressure, bending, and other load-up structural extremes. These will be tested again in the various types of loading. In the extreme program, the components will be tested alone, then in bolted joints, shear joints, and compression. The testing here will aim to reproduce as accurately as possible, flight load conditions. Finally, the will be tested.

Weight Constraints

Under physical characteristics, bench tests in the maximum down weight 115 lb. per sq. ft. This is in contrast to aluminum which is available from weight 165 lb. per sq. ft. In addition to its weight weight, bench tests characteristics include the retention of strength at temperatures above 1,000° in the largest advantage in its strength, weight ratio, a factor a smaller size piece of aluminum and steel would give the aluminum a three-to-one strength advantage.

In other areas, according to Norair records, the material has been successfully flame-treated in areas susceptible to temperatures between 1,000° and 1,200° using heat of aluminum. In addition, the material can be welded, this having been accomplished at temperatures from 1,000° to 1,200° using defocused thermal radiation of graphite. And bench tests produce results at the welding operation.

In addition to its work in bench tests, Norair holds a similar contract from the same ANK office which would the bench test contract, for the development of extreme temperatures and pressure for super alloy, steel. In this area, according to Van Horneschild, the company is making good progress and the knowledge derived from one program contributes to the other. It is, therefore, planned in the bench tests can be transferred to the steel work and vice versa.

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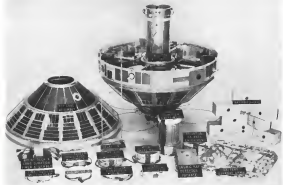


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COMPOSITE RADIATION PAYLOAD contained in the lens II which failed July 16, 1957 July 27, is 30% above instrumentation

Explorer VI Satellite Instruments Detailed

Washington Explorer VI when June 11 timer malfunctioned around 500 h after launch was instrumented to perform seven different experiments. These included:

Earth snail behavior: Six seasons of studies around the perimeter of the salt marshes, during which the snails do not migrate, showed that the fraction of the population which is affected is related to the earth and its thickness, as well as that portion affected by the earth and confined in the form of a fixed group of earthy bog water length. To summarize the two of the hemisphere-shaped seasons were combined that would have to absorb all salt water evaporating on the marshes. Two other hemisphere-shaped seasons were added to absorb salt groups of short water length and to absorb short, long water

lengths, and to assess their longer wave length infrared output. The counting two season Wild special outing which allowed them to dwell only short wave-length radiation. The experiment, crop risk, proposed by Dr. Hans Wacker of the Weather Bureau, was conducted by Dr. V. E. Swann of the University of Wisconsin.

- Heavy primary cardiac muscle formation

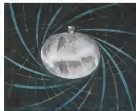
clusters assigned to ast and cometary particles, mainly α , with three different ranges, according to their atomic number (Z): light nucleus, heavy particles were selected to fall separately in solar wind sheets and nature of such nuclei was investigated. The results were compared to the data accumulated in 15-min intervals on tape, making it possible to compare measurements at different altitudes. Latitudes and times of the day of the satellite orbiting it have also been taken into account. The results are arranged in the space of the particles having different Z and E . The particles are distinguished by the earth's magnetic field into the geomagnetic equator and by penetrating to lower latitudes into the magnetic poles. For the first time, the composition of the particles in the G. G. Gerasimov of the Mariner 6 and 7 is shown in two masses.

• **Vogel Island** (indicated) Two Gough counters were installed. One, rectangular and sealed in a bucket of 2.0498, was designed to measure intensity of radiation in the Vog Island belts surrounding the earth. The other counter, shielded with a layer of lead one inch thick, was sealed 128.1. The experiment was conducted by Dr. Van

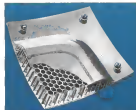
• Solar cell exposure: Purpose of this experiment was to determine whether gamma quartz asbestos normally carried in desert silicon solar cells from gas jet manufacturing damaged an earth detector. In addition to pretreatments, silicon cells covered by Explorer VI-1 power source, the offshore, who had an originally anticipated cell about one out of 100, was to be taken out back to determine effects of exposure. Experiment was conducted by Army Ballistic Missile Agency and the Naval Corps Research and Development Laboratories.

• **Melanocytes** Nissl-type dendrites developed by Neural Research Laboratory, can detect impact of microcosm, or this is small as 10 neurons in diameter. Detects contents of those cadavers in the photoconductor. Two of the three cells are fused with two aqueous film. When microcosmic strike cell it produces a fire, but that passes into light, causes cell's resistance to drop. Third cell, shielded from microcosmic fire, is fused by two, push, to produce calibration reference for scoring cells under changing orbital conditions.

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Guidance Temperature-sensitive material also is included to calibrate detectors for changing ambient temperatures. Experiment was conducted by Housa E. LaGon of National Aeronautics and Space Administration.

• **Gamma-Ray, soft X-ray** Cylindrical photometric sensor diodes, fitted with window made of lithium fluoride and sensitive to radiation wavelengths of 1,040 to 1,340 angstroms, was designed to measure Lunar Alpha line of atomic hydrogen at 1,216 angstroms. Scientific and response of six channels was designed both for several inches and for increased intensities, which resulted at time of launch because of high ambient activity. The X-ray sensor chamber was of similar design, fitted with oxygen gas and fitted with a boron-coated window to make it sensitive to wavelengths of 1 to 15 angstroms. A photo cell also was included to determine the aspect angle between the satellite and the sun for collection efficiency.

• **Temperature measurements** To provide satellite experiments internal and shell temperatures have been obtained indirectly by shifts in frequency caused by changes in value of resonant elements due to temperature change. Such data is not considered adequate to explain the temperature history of outer electronics, NASA says. For this reason, specific measurements were planned to determine temperature of a very isolated test area, a solar cell cluster, the battery pack and one of the Van Allen Geiger tubes. Indirect temperature measurements also were to be obtained from the heat balance and microelectronic experiments.

Explorer VI was equipped with two radio transmitters. One operating at 105 mc and transmitting over a modulated



SPACE information gathered by Explorer VI compares radiation satellites would have been relayed to ground stations by this intricate 105 mc transmitter.

ful loop antenna, was to serve as a beacon for ground tracking stations as well as to retransmit back measurements made in the microelectronic experiments.

Microelectronic experiment signals are to be plus, modulate the 105 mc transmitter.

Proton's telemetry transmitter operates at 25 mc and uses a variable type

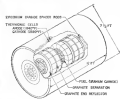
antenna which rotates precisely pole and waves in the direction of the satellite's spin axis and linearly polarized waves perpendicular to this axis. The four quarter-wavelength elements are twisted up in the plane of the satellite "equator" during launch, and are unrolled to a wall-wave wave satellite in orbit.

Four-frequency shift-level subse-



Vehicle Would Use Ion Propulsion in Space

Lockheed Martin and Space Division has proposed a space vehicle (built to be propelled by a low thrust ion rocket after vehicle and nuclear reactor are boosted into space by a chemical rocket). Specialty would be supported from reactor by a wall-wave coaxial cable for radiation protection. Reactor is at 2,000°C and "boils" electrons off thorium-coated cathode ends of reactor thereby directly producing electrical energy which is transmitted through cable to power static propulsion system. Total power (still of 10 kw unit) would be 1,000 kw.



mer modulation, with carrier frequencies of 560, 718, 960 and 1,180 cps, are used to convert signals from individual component sections into a composite signal which is used to modulate, modulate, the 20 mc transmitter.

The all-transistor transmitter has an output of 0.6 watt and consumes 2.6 watts power.

Electric power is supplied by an eleven of 481 nickel cells and nickel cadmium rechargeable batteries. Cells are located around the outside of the CR-34, so that temperature changes exposed to weight regardless of altitude, its role.

Reflective Shielding Cuts Space Fuel Loss

Wright-Patterson AFB, Ohio-Single small low reflective shielding can keep annual evaporation in an acceptable 5% loss in liquid hydrogen reducing weight.

Moreover, suitable containers for the storage of liquid hydrogen or other cryogenic propellants in space can be developed without the need for further heat transfer research, according to Wright Air Development Center task scientist Kenneth B. Gomer in his report, "Ch-

arged Storage of Cryogenic Fluids."

Gomer's conclusions are based on a detailed radiative heat transfer analysis of a multiple layer, spherical, liquid hydrogen container assumed to be in an equivalent orbit 200 mi. above the earth. Other assumptions were that no active heat transfer is the dominating factor at this altitude and that convection heat transfer is negligible. Also, only the radiative heat loss from the inner and outer walls was considered, not those from these radiating bodies.

The spherical space tanker gathered by Gomer consists of a number of progressively smaller shells made in order that each separated from the next by an evacuated space, with the liquid hydrogen contained within the innermost shell. Equilibrium temperature of the outer shell is calculated to be -110° F. To get the lowest possible inner temperature, for the sake of the outer surface is covered with a white lead paint and the outer surface is coated with silver.

Under these conditions, it is calculated that hydrogen loss can be kept below the acceptable limit of 1% per year by using six reflective layers between the inner and outer walls of a 25-ft diameter container three layers in a 58 ft container and one layer in a 100 ft container. A surface 200 ft. in diameter would leak only 4% of its stored liquid hydrogen in about one lifetime from between the outer and inner walls.

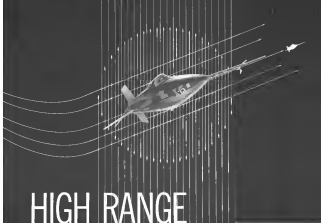
On the other hand, Gomer points out an area of up to 30% of the calculated equilibrium temperature is multiple the estimated loss figure. In most cases, however, the use of additional reflective layers would bring the loss down to the acceptable 1% figure.

At the same time, there are some potential problems with the orbital storage of cryogenic propellants which Gomer lists as: require research among these are the development of lightweight structures and protection against outgassing, particulates.

Amcel Propulsion Buys Oerlikon's U.S. Plant

Amcel Propulsion, Inc. has purchased Oerlikon Corp.'s sold propellant plant in Asheville, N.C.

The Swiss-owned plant built in 1951, was able to obtain on propellant contracts in the United States. It is owned by Amcel, with the active support of Oerlikon's Chemical Division, is working on the development of high energy solid propellants both composite and double base under a Navy contract. The company's plant is also an manufacturer of propellant anti-matter loading and launch.



Radar and telemetry equipment capable of spacing a speck in space records historic flights of X-15 across three-state test range

Built by Electronic Engineering Company of California

When the Air Force, National Aeronautics and Space Administration and U.S. Navy authorized a 485-mile "space" spaceway, 50 miles wide, for testing North America's new X-15, they sought a company with enough space-age background to design and build everything from radar digital data systems to access roads.

Awarded that prime contract was Electronic Engineering Company of California, a research and development firm with more than a decade of electronic range measurement experience gained at Cape Canaveral and Point Mugu.

Along the range between Wendover, Utah, and Edwards Air Force Base, California, EECCo engineers established two radar and telemetry communication umbels on mountain tops near Dry and Barry, Nevada, a third, the center control station, was set up at the NASA High Speed Flight Station, Edwards Air Force Base. Each station incorporates a space-

porting system, a precision data recording system and a constant-contact air-ground communications system.

When the X-15 drops from the B-52 mother ship and away into space, this electronic complex goes into action, providing flight test engineers with a continuous stream of vital information. A flight surgeon, for example, will watch a radiotelemetry of the pilot's heart action, as well as a dynamograph of his body temperatures, three engineers will give the pilot as much by watching and recording critical pressures and temperatures; every event in space will be faithfully recorded.

From the data teleported to the ground and recorded within the X-15 will come the knowledge required for man's next step into space.

A divided report on HIGH RANGE is contained in EECCo's latest R&D Review. For your copy, write the Technical Literature Department.

Several important career opportunities have just opened up in EECCo's engineering department. For further information, call or write Mark Perkins.



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HOW SAC'S "HOUND DOG" SCENTS ITS TARGET



The crew of the B-52G starts up the jet engine of the sharp-nosed GAM-77 Hound Dog missile hung under its wing...gives its inertial autonavigator the location of the target.

On a "for-real" mission, the Hound Dog would leap toward its target at supersonic speed—very likely a ground-defense center hundreds of miles away. Its guidance system can't be jammed...can't be decoyed.

Purpose of the GAM-77 air-to-ground jet-powered guided missile is to increase the striking power of Boeing's B-52. Using a pair of Hound Dogs under the wings of the new B-52G—and you have what amounts to a brand-new weapon system.

The GAM-77 program was started in August, 1967. The missile has been put into accelerated development. It already is in its early flight test phase... will be deployed by 1969.

Weapon system contractor: the Missile Division of North American Aviation.

MISSILE DIVISION



NORTH AMERICAN AVIATION, INC., BOWEN, CALIFORNIA



LAUNCHER developed for ARCAS rocket is a short launch tube which is pivoted horizontally for loading (AVF Nos. 1, p. 49). Bore-lit ARCAS rocket is partially encased, during the pivot from upright which keeps the rocket aligned during launch and which fill away when the rocket leaves the launcher. Launcher is positioned nearly vertical for firing ARCAS is a solid propellant cartomorphous rocket designed to carry intermediate loads to 250,000 ft. built by Atlantic Research Corp.

New Fast-Cure Solid Propellant Developed by Atlantic Research

Washington-Photobase solid propellant with flexible working conditions and with the capability of being cured almost instantaneously has been developed by Atlantic Research Corp.

Atlantic Research's Anate propellant process uses a physical method which cuts processing time, allows a variety of chemical formulations in the propellant and produces a cure that can be used simply by raising it to curing temperature for a period of a few minutes.

Like other solid rocket fuels, Atlantic Research has done considerable research on the use of aluminum with solid rocket grains, and the Anate propellant is aluminum. SAC studies indicate that aluminum solid grain produces boost velocity increases ranging from 10 to 24% over propellants without aluminum. These increases translate into range or altitude increases of 15 to 60%.

The Anate process involves a fast-cured, standard chemical process, as well as a short, in-process curing technique using microwave radiation of plastic suspended in a plasticizer oil. An overcoat is added to the shell, along with powdered aluminum and any other specified additives. For studies of physical properties

of the propellant mix, Atlantic Research has found that pellets or cylinders can be used as an inert element to replace the oxidizer for safety reasons.

A major advantage cited by Atlantic Research for its six propellant mix is that it has a long pot life. It will stay in a workable liquid state for periods of 50 days or more, permitting batch mixing of the mix before it goes into its next processing step.

Raw propellant mix is connected to a solid grain in heating. It is poured into its mold and heated with a vacuum jacket to 190°. When the propellant reaches this temperature, the plasticizer oil flows with the plastic spheres almost instantly, into a solid plastic mass, and the grain is cured. It is then cooled, trimmed and loaded into its case.

Right now, Atlantic Research is making its physical grain with standard curing methods, but the company also is developing an extrusion process that would provide a fast, continuous production system. Extrusion meters are now being run on a pilot base. With this extruder, the moving action of the screw heats the propellant to a degree, and more heat is added through a jacket around the extruder so that the mix will reach the proper temperature to cure at



PUMP PRIMERS

by
Arthur A. Nichols

Can You Answer These Questions About Gerator Pumps?

1. How many moving parts are there in a Gerator pump?

Only 3: your gear and rotor. The rotor has one less tooth than the mesh on gear. This "meshing" action moves the diaphragm (the piston) back and forth to displace gas. (See Fig. 1.)

2. What fluid will it handle?

Any fluid of reasonable viscosity in operation to 100 gpm at pressure up to 1,000 psi.

3. Is it self-priming?

Yes. Under normal conditions, a 10-inch line may be depressed to 25" or 30" in vacuum.

4. Will it handle impurities?

Because of its ability to handle impurities in fluids, a well-known manufacturer of laboratory gases, the Gerator is the best positive displacement pump on the market.

5. Is it dimensionally balanced?

Yes. Both moving parts are symmetrical about their turning centers.

6. What kind of valves does it require?

Unlike reciprocating pumps, the Gerator requires no valves.

7. Is corrosion a problem?

Gerator does not corrode even when the rotor or gear is exposed. In any event, corrosion is not normally destructive to Gerator.

8. What kind of flow does it generate?

A relatively pulsation-free. A 30-gpm machine and building has proved that it produces the smoothest flow among all positive displacement pumps.

9. What are its volumetric and mechanical efficiencies?

Volumetric efficiency ranges between 90% and 95%. Mechanical efficiency is usually about 80% to 90%. An inlet pressure up to 100 psi.

10. Can it perform multiple functions?

Yes, and in a single housing! Because Gerator elements revolve around a common shaft, several sets of elements in various sizes and capacities can be stacked within one housing to perform laboratory, measuring, coating, blending or other services.

Technical assistance is available and your inquiry is invited.

W. H. NICHOLS CO.

Wood Ave., Woburn 54, Mass.



Checking Regulus I surface-to-surface missile prior to launching from experimental cart. For the use of BQ-Cr-Mo steel castings in the launching cart,

Chance Vought was judged a National Award Winner in the Third Product Development Contest sponsored by the Steel Founders' Society of America.

How castings of 4330 nickel-alloyed steel help boost a missile up, push assembly cost down

BQ-Cr-Mo steel castings replace 73 detail parts, eliminate 260 hardware items in new launching cart

Regulus I, made by Chance Vought, is usually hoisted skyward from a rail launcher. The Navy, however, wanted a more economical launching technique that would utilize a carrier's powerful catapults... that would also simplify handling of the missile aboard ship.

The answer was the expendable catapult cart you see above.

The carts, also made by Chance Vought, are assembled with 30 cast 4330 steel cluster parts welded in place of the same material. These castings replaced 73 detail parts required in the plate-type fittings of the experimental carts used to prove the idea. They also eliminated 260 hardware items, such as bolts and nuts. Assembly is easier, and the carts economical.

Why BQ-Cr-Mo steel for the castings?
The 4330 composition of 1.45% to 48% C, 20% to 30% Ni, treated to 125,000 and 150,000 psi gives these castings the combination of high strength and great toughness needed to stand up to the tremendous shock of take off.

What about your product? Can it use the economy, high strength, and shock resistance offered by BQ-Cr-Mo steel castings? You can get complete information by writing:

THE INTERNATIONAL NICKEL COMPANY, INC.
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the time it passes through the extruder. Some Arctic formula uses a polymer chloride resin as its plastic and environmental packings for an oxidant, but a variety of ingredients can be used. A plastic propellant using an ammonium nitrate oxidizer and a double base binder has produced a theoretical flame temperature of 2,600° while Atlantic Research finds that a polyvinyl chloride-ammonium perchlorate combination with such high energy add-ons as aluminum yields a theoretical flame temperature of about 3,600°.

ARC has developed formulations within the Arctic family with burning rates (at standard reference pressure of 1,000 psi) from approximately 0.1 in. per sec. to nearly 1.0 in. per sec. by changing the burning rate additive. Formulations have been fired successfully in rocket motors at conditions ranging from -100° to 250° by modifying plastic binder elements.

Since Atlantic Research has been working primarily in the field of small and medium size solid propellant rockets, its plastic-binder propellant work is in that area. No one really sees barriers for the plastic approach, however, that don't apply to the more widely used rubber-binder propellants.

Atlantic Research observed the plastic propellant technique at the opening of its new headquarters and laboratory building just here in Fortier County, Va. ARC has a number of small control rockets and retro-rockets in production, along with the ARCAS meteorological sounding rocket (AVC No. 1, p. 49).

ARCAS, member of a family of three ARC sounding rockets, has flown to 249,000 ft from White Sands Missile Range and is designed to carry 12 lb. to 205,000 ft from sea level. Production is scheduled to 130 per month by the end of the year. ARCAS is designed as a low cost, high volume sounding rocket in the \$500-\$750 price category, although present cost is higher.

Along with ARCAS, Atlantic Research has developed Arcon, which is designed to carry a 40 lb. payload to 75 mi. and, designed to carry a 100 lb. payload to a 130 mi. altitude.

Army Cancels Frangible Nike Hercules Booster

Army has canceled the development contract for a single-bore frangible Nike Hercules booster. Theodora Chemical Corp. was developing a single-bore booster with a plastic case which, at a ground safety measure, would be ruptured into very small pieces after it burned out and separated from the missile. Frangible boosters would have replaced the four clustered, metal Nike Ajax boosters now used in a Nike Hercules test stage.



Systems on Leading Projects Depend on NORDEN CONVERTERS

Why are Norden encoders specified for systems on these vital projects? The reason, of course, are their high accuracy and reliability.

Typical performance is shown by the Self-Selecting Variable Shift Position Encoder, one of many Norden converter types. It offers automatic error-correction, coupled with the completely unambiguous parallel output produced through Norden's unique code that without extensive external break selection logic. The result is highest accuracy and reliability. Accuracy in the model shown is 1 part in 124,283.

Other features are small size (standard 100 mil. 18 system mount), longer life (4,000,000 revolutions at 200 RPM), and wide versatility, all backed by Norden's engineering and maintenance and modern production facilities. Call TRS 4-4721, or write for complete technical data or engineering consultation on applications.



Sikorsky S-62 -a new look in helicopters

- OPERATION:** From land, water, shipboard, snow, ice, mud—almost anywhere.
- RELIABILITY:** Millions-hour, time-proven components.
- ADVANCED DESIGN:** Increased payload, higher speed, more cabin space—all for less weight.
- POWER:** General Electric T-58 gas turbine, tailor-made for 'copters.
- THE NEW LOOK:** A sleek boat hull—and smoother, quieter, more comfortable operation—making new 'copter converts everywhere.
- SIKORSKY AIRCRAFT,** Stratford, Connecticut.
A division of United Aircraft Corporation.



Chance Vought Plans New Diversification

Dallas-Chance Vought Aircraft, in another step in its diversification program, is reorganizing its operations into four new divisions.

The new divisions organization is the latest move Vought has made as it drove toward more diversified operations with a broader market base (AVR April 6, p. 31). The program has been backed with greater urgency, in the past six months, following cancellation of the Navy Republic II and T-325 projects last December.

Four of the new divisions—Aeronautics, Electronics, Range Systems and Research—are good indications of the new direction in which Vought is moving away from its old position as primarily a producer of Navy combat fighters. Vice President Armand C. Blacklock, who was general manager of operations here, will now be responsible for the new Aeronautics Division and for the Range Systems Division.

Blacklock also will be responsible for forming the Electronics Division and the Research Division, both of which will be implemented soon. Chairman Vought President Fred Denbeck says the new divisions will be supported by strong basic and applied research programs strengthened by development of a Chance Vought Research Center which "will consist of certain specific research functions aimed at generating new knowledge by scientific work, as on ideas in a creative atmosphere."

Aeronautics Division, headed by Vice President W. Paul Thum, will concentrate on planned aircraft atmospheric studies, air vehicle systems, device technical weapons and subsonic research work. This division will be handling the F-10 production program, which is the bulk of Vought's business at the moment.

In the aeronautics field, the company has the prime contract for National Aeronautics and Space Administration's Project Scout. Detector and space technology is an area where the company has "made a strong beginning and in which we seek a position of leadership."

Under the reorganization, which becomes effective Aug. 1, J. A. Clark will be general manager of the Aeronautics Division. S. O. Perry will manage the Range Systems Division. H. B. Gibbons will be associate director of the Research Division; a director will be named later.

D. G. Gilmore has been named assistant general manager, and Fisher Moore will head the company's customer relations and foreign sales department with headquarters in Washington, D. C.



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The Arizona Bullock Buster

(cont'd from inside back cover)

Damage to tanks and 14 Frank Luke, 36 of the 27th Aero Squadron had scored another air victory. If the bombing was good, Luke could start two balloons in evening, in spite of the fact that such weapons were produced by 20 to 50 machine guns, lighter planes, and thousands of rifles fired by its ground crew.

Luke's strategy was to strike at dusk, where German defenses were down. He received 15 enemy balloons and 5 planes in 17 days was Luke the Michel d'Azoum, 17th Aero Squadron's greatest and intensity above and beyond the call of duty. "No one ever equalled his records of 13 planes and 2 balloons in 50 minutes or 14 victories in 8 days."

Luke shot down his last balloon on September 12, 1918, shortly after he had been assigned to Squadron 17. His only close friend was Lt. Joseph Webster. Because he effected a beautiful manner

Luke was never popular with his fellow aviators. He was an undisputed cowboy from Phoenix who liked to spend his Saturday nights drinking champagne—but Sunday's found him depositing his winnings on the collection plate in church.

Luke and Webster formed a balloon-busting team. They flew French-built SPAD XIII's which were powered by 230-hp Hispano-Suiza engines to a top speed of 130 mph. The SPAD was characteristically the strongest of all Allied fighter planes, and Luke tested its strength early every evening until the end of September.

About dusk on September 10, Luke pointed out two observation balloons and found five destruction to the man. They were shot last night (and two miles behind the German lines). Less than a half hour after taking off, Luke was back at his base—unscathed—mission accomplished.

On September 10, just six days after

his first victory, Luke and Joe Webster were lighting at dusk. Webster never returned, he gave his life in quest of glory in the days that followed. Luke performed in his alone and often showed an open disregard for the orders of his superiors.

In less than six weeks of active flying at the front, Frank Luke accounted for 18 kills. He disappeared on Sunday, September 23, with no immediate clue to his death. It is almost a certainty that Luke was the unknown aviator who was killed near the village of Vauxman that late Sunday. According to French newspapers, the aviators shot down three balloons and two planes, then fired hand grenades to kill 11 German soldiers. Apparently injured, the pilot then bled, stayed from his plane and refused a landing. He died from his automobile.

On November 9, just two days before the Armistice, Luke's promotion to First

Lieutenant was received by his squadron. The intrepid Aviator had been missing for 41 days.

Heritage of the Air

One of the most inspiring chapters in the history of flight is the story of the men and flying machines of World War I. It is the highly personalized story of brave men—and the need, want, and hope that motivated manpower to achieve through it shares the story that Leach Corporation is proud to present this Heritage of the Air Series.

Leach Corp. is indebted to Major Kenneth S. Brown, USAF, for contributing to the historical reliability of this document. Those devoted to leading historical authority has committed to serve as Technical Director for the Heritage of the Air Collection.



COPIES FROM AIRDOSSA: 1995 on September, church on Sunday

WHOSE JOB IS RELIABILITY?

It's a loaded question, and we have no stock answer. But one thing is sure—reliability is not solely the responsibility of the man in quality control. Reliability is a corporate philosophy in working clothes.

At Leach, it begins at the top (or at the bottom) and pervades our organization. In one form, it comes from the engineering department. It is found in the multitude of peaking activities performed by our quality control specialists. And it comes off the assembly line as an integral part of our finished product.

In the production of reliable, cost-effective components, for example, even the Leach craftsman bears a big share of responsibility. His job is to help maintain a controlled, dust-free atmosphere. He knows why his job is important.

Reliability, like capability, is a tradition at Leach. Here, reliability is everybody's job. As the pace of technological progress quickens around the world, everybody knows that that job is so important.

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Power Conversion Equipment • Control and Guidance
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THE HISTORY OF FLIGHT is a fascinating documentary of man's quest for airborne reliability. For more than a quarter of a century, Leach Corporation has made significant contributions to the search for ultimate reliability by constantly refining one basic corporate philosophy: determined concentration on optimum product dependability.

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This best explains why Leach components and sub-systems can be found in the vast majority of today's operational aircraft and in most major missile projects. In large measure, this is why Leach is uniquely equipped to meet the varied challenges imposed by the new and constantly evolving concepts of today's weapons and communications systems.



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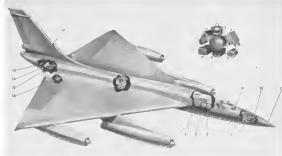
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AN/ASQ-42 bombing and navigation system components are installed in General's B-58 Hustler explosive bomber as shown in the cutaway above. Numbered details are: (1) magnetron coupler, (2) magnetron antenna unit, (3) auto tracker, (4) auto tracker amplifier, (5) precision aerodynamic stabilizations unit, (6) stabilizations computer amplifier, (7) radio altimeter amplifier, (8) stabilizations computer, (9) search radar RTM unit, (10) search radar antenna, (11) search radar photo receiver, (12) release, (13) doppler radar transmitter antenna, (14) doppler radar electronics package, (15) doppler radar receiver antenna, (16) photo data indicator, (17) radio altimeter EDA unit, (18) radio altimeter RTAR unit, (19) remote computer transmitter. Weight of full system, including releases, is slightly less than 2,000 lb.

First Details of B-58 Bomb-Nav System

By James A. Funes

Great Neck, N. Y.—First details of the AN/ASQ-42 bombing and navigation system developed for use with the General B-58 Hustler bomber system have been disclosed by the manufacturer, Sperry Gyroscope Co.

The system combines active radar navigation techniques employed during the approach phase of a mission with passive inertial and radio tracking techniques that enable the B-58 to avoid detection by reconnaissance resources once it is over enemy territory.

Cost \$110 Million

The AN/ASQ-42 system has been in production at Sperry for over a year. To meet the requirements of accuracy and flexibility for the system, Sperry's development program required more than 1,000 man-years of engineering effort and more than \$110 million.

Basically, the system consists of an analog computer that receives data from doppler, stellar, and inertial sensors and continuously computes air craft position and heading, corrected periodically by means of search radar data. The primary inputs to the navigation computer are from the inertial

system which provides short period velocity information; the doppler radar for long period velocity information; the auto tracker for precise heading; the search radar for position fixes; and the radio altimeter for precise altitude information.

The operational features provided by the AN/ASQ-42 system are:

- Precise preset profiles.
- Continuous ground speed supplied by the doppler inertial system.
- Semi-automatic correction of preset position.
- Semi-automatic collection of altitude and speed.
- Automatic radio tracking for accurate heading.
- Automatic great circle steering to any desired destination.
- Inertial coordinate system for accurate point-to-point.
- Automatic radio compass bearing.
- Advance storage of targets and off-set points.
- Automatic radar photography.
- Map computer to aid in target, waypoint, and target identification.
- Airborne battle computer.
- Inflight multifunction detection and correction.

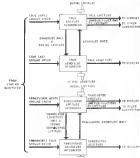
The AN/ASQ-42 heading and az-

imuth system is made up of its precision mounted functional subsystems and was interchangeable subsystem which is changed in accordance with the job being carried. The interchangeable subsystems described here consist of computers with the heading heads and fast pods can be carried for each special mission in reconnaissance and countermeasures.

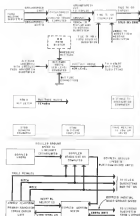
Seven Subsystems

These seven subsystems are:

- **Vertical information.** The vertical subsystem provides the spatial reference for measuring pitch, roll, and heading and, in addition, measures ground speed, true air speed and wind. The spatial reference is provided by an inertial system which maintains a platform tangent to the earth's surface. The position of this platform relative to the aircraft furnishes the measures of pitch, roll, and heading. The inertial system also provides a measure of velocity. Long term ground velocity is normally derived data are reduced by moving the data with ground velocity information supplied by the doppler radar. The resulting measure of ground velocity provides both the short term accuracy of



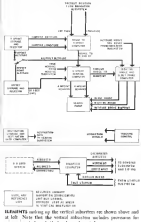
NAVIGATION SUBSYSTEM (above) and indicator information (below). Seven subsystems make up Sperry's bombing system.

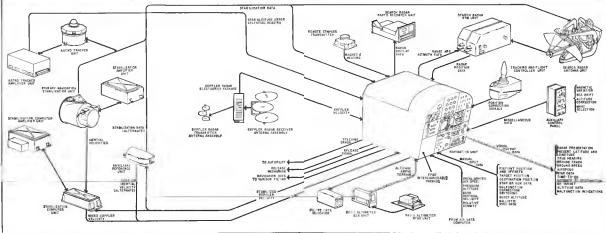


AVIONICS



HEADING SUBSYSTEM (above) and lighting information (below). Heading information includes atmospheric data mapping.





SCHEMATIC DIAGRAM of complete D-USA/N₂ loading and evacuation system shows data flow between elements of the system. System

AUXILIARY control panel is mounted in the 2-15 second station compartment. It contains controls for the indicator solution.



The inertial system and the barometric pressure sensor of the Doppler radar. Trace sampled is computed by measuring the Doppler shift of the radar return. The ground velocity of the aircraft can be double-integrated to compute the wind drift is computed by subtracting the measured velocity from the ground speed vector.

Navigation information consists of the latitude and longitude of the aircraft in both north and transverse coordinates. The ground track data for other aircraft is also available. Information gathered from the telemetry information obtained by the vertical reference and heading information obtained by the heading reference. Velocity vector data is also available. The information is presented in two coordinates and in transverse coordinates. These components of velocity are computed with respect to track to determine the relative velocity of the aircraft.

Altitude information is presented in both altitude and position information.

imposed on one coordinate system can also be calibrated by the positional information supplied by the other coordinate system. This is the basis for the following two types of heading systems:

- **Heading, reference system.** The heading reference system determines the true heading of the vehicle by using the reference relationships between the various coordinate systems used in the primary navigation system, and converts various signals from one set of coordinates to the other. This system is used to determine the direction to the destination or target and to derive steering and surge signals for the course. True heading of the aircraft at any time and true course combination is the basis for the heading reference system.
- **Heading, inertial system.** The heading inertial system is based on heading information furnished by the vertical sub-system. Known rate of change with respect to the earth's rotation and inertial's target heading rate are compared to the heading rate to derive heading error and used to correct inertial heading information.

variables: aircraft position in north coordinates, heading, ground speed and track, TAS and wind, altitude, attitude, storm data, distance to track.

computed in this manner is continuously corrected by means of an auto-tracker which determines the relative bearing and latitude of tracked stars at night and the sun during the day. The error between the computed relative bearing of the star and its measured relative bearing is used to correct the heading information in the system. The heading subsystem also computes a great circle course to any destination by deriving steering error signals between the desired and actual course of the vessel.

NAVIGATION mode for the E-SI ANALYZER local-area system.



True Airspeed Computer for Martin Seamaster

A compact, highly accurate True Airspeed Computer to operate under extreme environmental conditions was required as a navigation aid for the U.S. Navy's Martin P6M Seamaster. Gianni met and exceeded the requirements by designing a simple electromechanical computer that employs two Gianni transducers, one temperature probe and a single servo computer to produce a shaft output proportional to true airspeed...the result of years of experience in the development of air data instrumentation.

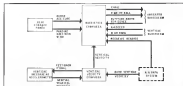
The system occupies only 300 cubic inches...three-eighths the space allotted by the customer...and, it is twice as accurate as conventional mechanical computers while performing in any position without shock mounts or vibration isolators. Additional information on the True Airspeed Computer is available on request.



Giannini Controls Corporation

916 East Glendale Street, Pomona, California

Engineering opportunities now exist at Gianni for work as stellar avionics systems. Interviews possible by writing to the Director of Technical Personnel.



ENGINEERING selection in the interchangeable subsystems of the AN/ASQ-42. Other subsystems replace this one when the pods for other systems are being tested by the B-57.

along a great circle course is also computed by this subsystem. Altitude above sea level is generated by converting barometric altitude with altitude data obtained from the radio altimeter. The relative bearing and altitude of a star to be tracked by the auto tracker are computed from information supplied by the sighting and heading subsystems.

• **Sighting subsystem:** The sighting subsystem computes the computed position of the aircraft, provides a means for automatic radar mapping, and generates data for other subsystems. The computed position of the aircraft is cor-

rected by using the known position of a point on the earth's surface within radar range to compute the dead reckoning bearing to the point. The computer corrects its computed position by using a constant to bring information into accordance with the sea point in the search radar display. The position of an unknown point on the earth can be established in the same manner. Automatic radar mapping is accomplished with an automatic radar scope and a photo recorder. An automatic mapping concept enables the radar to track, summarize points along the aircraft's ground track, and the spacing

Equipment Weight

Pilot's Data Indicator	44
Navigation Unit	856.5
Acoustic Control Panel	57
Tracking and Flight Controller Unit	40
Auto Tracker Unit	10.2
Auto Tracker Amplifier Unit	18.1
Power Navigation Substation Unit	91.7
Substation Computer Amplifier Unit	19.6
Substation Amplifier Unit	10.3
Substation Computer Unit	89.2
Remote Control Transmitter	1.9
Search Radar STM Unit	814.0
Search Radar Antenna Unit	1153.0
Search Radar Photo Recorder Unit	440.0
Search Radar Receiver	1501.0
Search Radar Wave Guide and Wave Guide Path	0.9
Search Radar Apple Filter Unit	32.0
Display Radar Electronic Assembly	114.0
Display Radar Electronic Package	58.0
Display Radar Receiver Antenna Assembly	124.0
Display Radar Transmitter Antenna	25.1
Display Radar Receiver Radiator	274.0
Display Radar Wave Guide and Wave Guide Path	3.3
Display Radar Rhinoceros Transponder Control	4.0
Display Radar Display Filter	11.1
Autodrive Reference Unit	55.0
Radio Altimeter TCA Unit	18.9
Radio Altimeter RTAR Unit	14.2
RTAR Interchangeable Package	57.6
Total weight (pounds less radome)	1,747.2
(pounds, including radome)	1,942.5

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NEW AMPLIFIER CUTS NOISE TO BOOST RADAR RANGE 40%

This new isolating parametric amplifier made possible the reception of Pioneer IV signals through more than 400 000 miles of space. Because the newly tuned amplifier can receive or reject a more signal, General Electric's testing station accomplished the feat using a standard 18-foot dish antenna. This was four days after blow-off, with the satellite transmitting a signal of less than two tenths of a watt.

Since that time, G-E parametric amplifiers have been applied to existing radars and have reduced input noise by 6 db—equivalent to a 600% parametric power increase or a 40% addition to effective range. Active elements such as this continue to prove General Electric's outstanding technical competence in defense electronics. 001

Progress is Our Most Important Product

GENERAL ELECTRIC

DEFENSE ELECTRONICS DIVISION
HEAVY MILITARY ELECTRONICS DEPARTMENT
SYRACUSE, NEW YORK

of these points is adjustable as first success pictures taken by the photo recorder can be developed to form a continuous strip map.

• **Multifunction indicator.** The multifunction indicator provides a signal for detecting a malfunction in the primary navigation system and enables the navigator to switch to alternate methods so that the aircraft can continue its mission. Multifunction warning the system are detected by comparing the readings of the various indicators with four normal indications, and by warning selected system outputs. A multifunction tester and a pair of indicator lights indicate whether a particular event is "good" or "bad."

Concepting Multifunctions

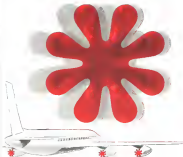
Multifunctions are remedied by a switching arrangement that enables the navigator to bypass the malfunctioning unit as desired by using an alternate mode of operation. Two of the main alternate channels are a fire tube which is used as a heading reference in the event of a malfunction in the gyro tracker and an auxiliary reference unit which is a standby reference unit that can provide absolute attitude and displacement vectors in the event of a malfunction in or during service of the primary stabilizer unit.

• **Heading reference.** The heading reference, which is interchangeable in comparison with the interchangeable pods for the D-55, computes true and base of ball, least point information,



Transistor Insulators

Insulators for power transistors which electrically isolate transistors can act as good thermal conductors to permit transfer of excess heat to water cooling, air circulation in variety of shapes and sizes by Vought Aircraft, subsidiary of United Car Furniture Corp., San Leandro, Calif. The drawings shown are heat conductors by the Hester process, developed by Amchem Corp., South Gate, Calif., to give them combining qualities.



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JET ENGINE TURBINE ROSE — MATERIAL: INCO 601

	1.1	1.2	4.1	4.2	5.1
		2%			(1300° F 10,000 lb./sq. in.)
	175,000	120,000	20	32	225 hrs.
Spec	150,000	100,000	12	25	25 hrs.

JET ENGINE TURBINE SHAFT — MATERIAL: WUPOALLOY
Superalloy Properties

	T.S.	Y.S. 32%	EL	RA	SA 1200" x 70 000 lb./sq. in.
	195,000	135,000	22	32	75 hrs.
Spec	160,000	90,000	25	38	25 hrs.

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forward electronic sales engineering company, at 14166 Via Vista Blvd. Shireman Oaks, Calif.

• **Electronic Systems Laboratory** is now near of Massachusetts Institute of Technology's Junior Semiconductor Laboratory. New name better describes spectrum of laboratory's efforts in computer and control systems. Prof. J. Francis Rutenfranz continues as director of the laboratory.

• **Western Electronic Manufacturers Association** is now under the banner West Coast Electronic Manufacturers Assn. (WECMA) (formerly WCEMA) and that 25% of nation's 57.5 billion electronic sales were made by western firms. Western membership was 134, 100, or 19% of industry total.

• **Magnetic Amplifier, Inc.** has moved to larger quarters at 136-140 Kissena St., El Segundo, Calif.

• **Phil-McCallough** reports a \$1,000 sq. ft. expansion, including new 27,000 sq. ft. building in San Carlos, Calif. and leased space in Belmont, Calif.

• **Edison-Pace, S.P.A.** is the name of new Italian communications engineering company formed by Bertolini Cossu and Società Edison di Milano, a major Italian electric power company. Headquarters, through an subsidiary, Pace Communications Engineers, Inc., is in 49% interest in the new company.

• **Computer Systems, Inc.** is the new name of the former Mid-Century Instrument Corp. New York City, producer of analog computer and simulators.

• **Thermo Instrument Corp.** will move to new enlarged quarters at Vista Street, Saddle Brook, N. J. on Aug. 1. Company makes hot equipment for industry.

• **Raytheon, Inc.**, Orlando, Fla., has moved its operations to new 22,000 sq. ft. plant on U.S. Highway 179, north of Orlando.

• **Gulton Industries, Inc.** has formed new Gulton Division which will specialize in extraction of useful information from, interpreted or signal data. New division is headed by Arthur S. Westcott and Dr. A. C. Rife formerly with Applied Science Corp. of Princeton (ASCC).

• **Coleman Electronics, Inc.**, in the name of new wholly owned subsidiary formed by Coleman Engineering Co. to produce and sell company's digitizer and related data processing systems. W. E. Carlson has been named vice president and general manager of the new operation.

• **Radio Engineering Laboratories, Inc.** has opened a new West Coast office at 2716 "B" St., San Diego, to be headed by Alfred J. Wronson.

• **Engineered Electronics Co.** has started construction of new 25,000 sq. ft. facility at Chesham and McGee Sts., Santa Ana, Calif.

95776 FILTER CENTER 05033

• **High-Power VHF Transistor-Passive Semiconductor, Inc.** reports development of a three power transistor capable of delivering 5 watts power at 10 mc. Models will be displayed at Western Electronic Convention in San Francisco, Aug. 28-31.

• **Navstar Tube** New Available—Small quantities of a miniature, small signal triode tube, called Navstar, announced earlier this year by Radio Corporation of America, now are available for trial by industry designers. RCA's Electron Tube Division has announced.

• **Interference Suppression—Conference on Radio Interference, Reception and Electronic Compatibility**, conducted by American Foundation of Research Institute of Technology, will be held Oct. 6-8 at Chicago's Museum of Science and Industry. Conference is sponsored by Army Signal Research and Development Laboratories. Oct. 6-7 sessions will be conducted, while the Oct. 8 meeting will present classified papers. Inquiries should be made to M. J. Lane, American Research Foundation, 10 West 25th St., Chicago 35, Ill.



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USAF-Cosmos Atlas 3 D (above) was one of five vehicles that provided ascent 6,500-nd. Right (AWF July 27, p. 40). Malfunction of launchers was detected after start, replaced ground line on the vehicle. First of the D series. USAF retro 11 of 26 Atlas test vehicle in being achieved 90% of time of test objectives, seven in achieving 25 to 90%, eight in achieving 15% or less.

Five USAF Atlas Vehicles Fail in Test Flights

Fuel flow problems caused shorts of Atlas 5C (left) and 5D (right). These minor faults in a fuel valve were made after extensive ground tests, and apparently shortened the trouble. Vehicle 54G, the first to incorporate these fixes, flew successfully last month.



MISSILE ENGINEERING



Atlas 7C (above) and 7D (right) carried experimental ablative nose cones developed by General Electric Co.'s Missile and Space Vehicle Department. Ground guidance and launchers caused failure of one, because cone was blunted by the failure of the other. The D model has heavier base, smaller instrumentation pod on one side than earlier nose vehicles.



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With Allison Prop-Jet power in your Super Conquest you will have other advantages. A spare parts and overhaul program is in operation. This includes a Unit Exchange plan which means you can greatly reduce your inventory requirements for spare engines, propellers and spare parts. It's the same plan already used by a number of the 13 airlines now or soon to be operating the Allison-powered Electra in world-wide service.

All this applies whether you are concerned with vehicle management or own and use aircraft as a necessary part of your own business. But to be more specific—



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With an Allison Prop-Jet Super Conquest, you will have an abundance of dependable power for quick, short field take-offs and rapid climb above the weather when the air is smoother. You'll fly in guaranteed comfort and you won't experience the noisy pounding vibration which marks piston engine aircraft. And even importantly you will save time—giving you more hours in the day, adding up to more days in the year to do your work or relax. You also gain time by having simple routine and comfortable overhauls on route. You can select the interior configuration which best suits your taste and convenience.

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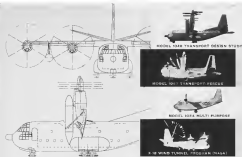


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Desired to provide the most comprehensive volume of flight test data is the U.S. Air Force X-18 (Baker), the world's largest VTOL project. Currently undergoing preflight testing at Moffett Field, California, the X-18 is scheduled for complete flight programs in the next few months.

Designs are now being delivered under contract to Hiller.

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Mobility Designed into Minuteman

Washington—Provisions for mobile launching of Air Force's Minuteman solid propellant intermediate-range ballistic missile, in addition to a basic scheme for firing from fixed underground silos, encompasses one of both railway, cars and trucks.

Adapting the automobile truck as a combination transporter tractor will not be so easy as using the railway car, but once both will be required to transport this ballistic missile from assembly site to its site, designing launch provisions into each form of basic container becomes a refinement of the fundamental transportation "exchange" for the weapon, to achieve strategic mobility to maximize damage of launchers.

Minuteman acceptance early in the nation's history that mobility would offset and provision for this type of deployment always has been in the Minuteman scheme.

Railway car transporter launchers could be of the booster or faster type, rapidly constructed to meet operating requirements, but probably not larger than railway cars now in operation. Boosters now run slightly over 50 ft. in length, boosters from about 52 ft. up to about 58 ft. or more for special low-bed types. Under existing design practices for the missile it would even be possible to adapt, with modification, railway cars now in use.

Existing railway networks would offer maximum mobility, with specially constructed spurs at various locations integrated to afford stopping places for railcars, ponds of time.

Manning Crews

Conceivably, undoubtedly will be used to launch missiles of Minuteman from air or ground. Unlike the scheme for the missile site area, sites, mobile launching will require manning crews which would travel with the railway car transporter launchers at other sites in the next stage.

Long future operational status is involved—the technique of using railway cars for transport launches will be investigated experimentally, wing designs remain in development progress.

Obviously, Minuteman is being designed in that existing railway, road beds will be adequate to handle the missile's weight, but probably it that bridges in the network may have to be upgraded to meet Minuteman requirements.

To meet the requirement for spotting sites in many remote areas, the basic transportation scheme for Minuteman missile must itself will develop with a dual capability—with a truck.



FIRST PHOTO of Minuteman's faststage solid-propellant rocket motor gun is shown being prepared for testing at Solar Aircraft Co.'s new manufacturing plant in Los Angeles. Visible at bottom of unit are those of the four exhaust nozzle attachment rings which will be used to launch the missile. Provisions of unit reflect that Minuteman fast stage about 5 ft. in diameter and about 15 ft. long, only the largest solid-propellant gun ever launched. Length of the stage is a controlling factor in development of thrust. The fast stage itself will be used as state tests by Thayer Chemical Corp. which, along with Aerojet General Corp., is concerned with propellant development for all three of Minuteman's stages. However, Foster Co. also is involved with third stage propellant development. Note does not specifically identify this fast stage motor number one in Minuteman's list area that it did continue the jet launch to launch Minuteman fast stage motor one.

rolled up on a railway flatcar for launching to a near a point the railroad can move to the site launch site. The truck will be rolled off the flatcar to transport the missile over existing, conventional roads as new roads if need is available in the area, to the site site. This consideration form of transport form for the missile would be in addition to lower capability to land by truck, alone between missile assembly site and fixed launching site.

Motor rail transporter design per-

mission have been fixed to the point of conferring to missile size, weight, and turning radius required to accommodate missile length. Truck transport (two requirement for Minuteman is a subcarrier responsible of Boeing Aerospace Co., Minuteman assembly and test contractor).

Being Minuteman's accelerated development, additional underground site facilities to check out Minuteman intercontinental ballistic missile booster stages are being pushed to completion.

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For more information please write to: Mr. A. B. Stevenson, Engineering Personnel, North American Aviation, Inc., Los Angeles 45, California

THE LOS ANGELES DIVISION OF

NORTH AMERICAN AVIATION, INC.



at Edwards AFB, Calif. to advance development in propulsion and various related phases of the aeronic. This direct is a major part of the new development approach adopted by Air Research and Development Command's Ballistic Missile Division, which has taken responsibility, Space Technology Laboratories performing major engineering and technical direction, and its materials and test contractor, Boeing Aerospace Co., and the numerous aeronic contractors charged with development of missile subsystems and building and test facilities at Edwards will be a combination of earlier research utilizing quality analysis-proven installations which have been in operation at Edwards for over a year for several test and subsystem work. (AW Jan 19, p. 58)

Propulsion Units

Propulsion units which will be developed in the new Edwards facilities eventually will be Minuteman first-stage engines in order to duplicate closely the launch characteristics of the future operational missile. The program will continue until the first stage engine, which will serve to boost the operational Minuteman into suborbital trajectory, has passed tests on a repetitive basis.

In addition to the booster knowledge

base, the jet the large amount of work at Edwards will be concerned with studies relating to the environment, effects and characteristics and design of launch ships—area which contribute to the design for the weapon system.

The site facilities which will be operated by Boeing under contract with ARMD, with support by Edwards AFB personnel will comprise dual installations, one virtually complete. Complex will consist of an assembly area and assembly building, shop, test and building and two underground pits, stretching along a length of approximately 1,500 ft. in a north-south direction.

Site No. 1 is located at the end of the road leading from the assembly building. Branching off from the road near its end is a spur which leads to site No. 2, so that there is approximately 400 ft. between the complexes. Roughly close to site No. 2 is a one-third mile test pit, probably for proving advanced stage tests.

Site number 20 ft. wide diameter are 45 ft. deep, and are fitted with a ladder and elevator. Rids installed in the complex pattern surrounding opening are used to seal areas the site closed for loading.

The Edwards site trials will supply most of the information being program which has been underway for a considerable period of time on solid propellant propulsion foundations designed for proving operational possibilities. This design program conducted by industry and military segments will stretch out for a considerable period. Results should indicate the outlook, is promising for highly successful propellant development by Minuteman.

Propellant Checks

New studies on the propellant focus lines being developed indicate that there will not be unusual susceptibility to shock and vibration. Regime design is considered the normal for launch characteristics and, as general, the propellant development is considered a relatively straightforward job. Checks on propellant decomposition rate—important with respect to long time operational storage in a sub-orbital that the characteristic will be satisfactory.

One of the great materials reached is polyurethane which with additives, becomes a polymer. Another is poly butadiene acrylic and actual grain material development will vary by the different manufacturers engaged in the development of the various solid stages, although at the stage of development, propellants are virtually in the same general performance area—all based on the same basic contract.

Propellant development steps now are being done at Aerojet-General

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top, drives, and mass-sentient, massive. Major experience has been centered on such products as safety, security, long-term use and positioning controls, ground test component. Which seems of the experience would be most helpful in the development of post projects, either India or the the future?

Complete follow-through from product development to product application is a standard procedure on every piece of material equipment that enters the Blawie-Columbian work. Every step of engineering, manufacturing, and testing is performed under the complete control of "one reader." For example, control systems components such as modems, solenoids, motors, pistons,

solves among elements and the like, use of Barber-Colman Company's own manufacturing. Metals are analyzed, treated, and finished in our own departments. Machining and gage holding are performed on machines of our own make. A few crystal lenses from the east (Barber-Colman development and manufacturing) are shown below.



Endothelial cells and pericytes/plasma cells, together with highly specialized cells of myo-endothelial origin, in many cases specialized on various sites, are all solid vascular structures.

METAL TIEFUND—a jewelry technique in which one part of metal and metal lugs are fused together to create a continuous surface, some degree of mobility, strength and durability and low maintenance needed.

HEAD-HEATING AND METAL RINGING—Beliefs of farmers, priests, and monks in parts of the land for all types of head injury. Pushing, rubbing, scratching, shaking, and blowing, with or without a candle, are used.



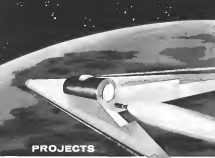
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PROJECTS

FOR FUTURE

DECADES IN SPACE... another Lockheed Project Report to Engineers

Plotting the nation's future space exploration projects requires the capabilities of a forward-looking company, one with vision, superiority in technical skills and advanced facilities. Lockheed, Burbank, long a leader in extending the science of flight, is placing its vast resources and accumulated knowledge into programs designed to provide major breakthroughs in the fields of basic and applied research, manned research of advanced design, missiles and spacecraft. Shown here are artists' renderings of a few of these important projects. Each project diversification calls for high-level technical skill, offers genuine challenge to experienced engineers. At Lockheed these varied projects require engineers in many fields. Take advantage of this need. Go forward with a forward-looking company. Lockheed, Burbank.



Supersonic Transports—have held an important place in our thinking for the past several years. Extensive wind tunnel tests have been conducted on many design concepts, supplemented by extensive laboratory and structural studies. Lockheed is prepared to build an airliner that will travel at speeds in excess of Mach 3 at an altitude of 75,000 feet.

Space Transports are under development now, capable of transporting a pilot and 1000 pounds of payload for three passengers—equipped to work in space—on an orbit of 1000 miles altitude. Designs are such that an operational vehicle will be feasible and practical in the 1963 period.

Infrared Systems studies are being conducted using an advanced method of detecting low-moving missiles and high-speed aircraft. A new facility, which includes an infrared laboratory with an infrared tunnel, for basic research and development of prototype equipment in this expanding field, has been set up to push Lockheed, Burbank, to the forefront in infrared study.



Vertical Take-off and Landing Projects—Lockheed Burbank, is engaged in exploring the potential of VTOL projects on a very broad scale. Different VTOL ideas are embodied in each proposal. Considerable emphasis is being placed on VTOL "air recovery" studies designed for air rescue and military missiles recovery missions.

Solar Radiation Studies—are being conducted at Lockheed's high test radio station at Inglewood, California, placing particular emphasis on solar flares on our contribution to the International Geophysical Year. We have already accomplished more than a quarter of a million stages of the test for sunlight. In cooperation with other companies, we will determine the processes by which solar energy is released.

High caliber scientists and engineers are invited to take advantage of Lockheed's expanding career opportunities. Opportunities now exist in: Electronics, auto and thermodynamics, propulsion, servo mechanisms, materials and processes, structures and stress, operations research, research in optics, infrared, systems, computer-aided systems, instrumentation, mechanics and hydrodynamic mathematics, and in all phases of design. Write today to: Mr. E. W. DeLozier, Manager, Professional Personnel Staff, Dept. 13981, 2640 North Hollywood Way, Burbank, California.

Wright Air Development Center—While an announcement has been made regarding the type of constant velocity system provided for use between Minuteman control station and isolated missile also, the prohibitive is that a unique system is being tested in place of looping with the prototype is under trial for evaluation also comes nuclear attack. This would deter that previous effort would be placed on a relatively unproven communication link.

One possibility is that development may be directed along lines of the earth control station system concept in which the transmission center is located below the earth's surface, sending are carried in a pair of buried electrodes (terrestrial) "underground" transmission through and along the earth's surface in carrying station (or under located at the missile site). General research in this field already is underway (AWM Mar 18, p. 35).

At the assembly and test contractor, Boeing will be responsible for a large amount of associated engineering required in the Minuteman research and development phase. This includes subsystem integration, interface considerations, and design studies to firm up basic concepts of the missile.

At general test contractor, Boeing will be responsible for conducting the job test plan at Edwards AFB, and will develop various units of hardware and associated test support equipment. Flight test equipment also will be a Boeing responsibility including tailing, system commissioning, and reduction of test information.

There is a projected total of about 551 man-years to be spent during Fiscal 1960, about 510 million dollars has been allocated to be subcontracted by Boeing for Minuteman research and development.

Under the concept along which Minuteman is being developed, it is not considered a direct replacement for present day ICBMs. It is termed an extension of present day ICBMs, a "stealth" more effective way of harnessing ballistic capability.

Minuteman also is intended to offer a much higher degree of deterrence. Extension of the number of Minuteman into satellites which will be required for a truly effective positive deterrent capability has not yet been set. Since the weapon system development is not sufficiently far along to require final decision. However, the general estimate now under consideration for Minuteman structural strength ranges from the middle hundreds to the high thousands. It is possible too, that ultimately, Minuteman also may be located in the far reaches of Canada, subject to Canadian permission.

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• Airesearch Control System for Auto Electronics (AE) Fly's first weapon system, provides information dealing with loading, navigation, engine start control, radio, automatic flight control and cockpit instrumentation.

Expansion in electronics and electromechanical activity is causing excellent openings at all levels for qualified engineers. Diversified programs include Control Air Data systems on Air Defense Command B70 and F 300. North American A-10 and McDonnell F 4H, as well as other commercial and military aircraft and missile projects.

Openings in the following areas:

- **FLIGHT SYSTEMS RESEARCH** General problems in motion and navigation in air and space; required background in aerospace physics engineering.
- **DATA SYSTEMS RESEARCH** Engineer with thorough auto-electronic background in electronics, analog, discrete and mechanical approaches.
- **CONTROL SYSTEMS** Work in preliminary design stage involves storage-theoretic analysis and testing computer techniques.
- **FLIGHT DATA COMPONENTS** Analysis, proposal, design and development work in the following specialized areas: analysis, servo theory (transducers, servomotors, airborne instrument and sensing development of high and low speed systems problems).
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⁴One of a series of ads currently appearing in such open-air magazines as *Parade*, *Amateur Work* and *O. S. News of World Events*.

NEW AVIATION PRODUCTS



Missile Component Centrifuge

Centrifuge tests aircraft and missile components under positive and negative g effects and high ramp functions.

Model A962 centrifuge has two oil-coated rotating tables mounted on the beam. One table driven from 0 to 3,500 rpm produces a resonating g field for testing acceleration-type components.

The opposite table drives electro-pneumatically, tests comparatively at one over three metres (up to 50 deg. to give out a light acceleration ramp function). The main axis is controlled through an electrohydraulic servo system. 140 rpm rotation can be stopped at any speed by a hydraulic locking mechanism.

Gowanus, Inc., 2235 Federal Ave., Long
Island City, N.Y.

Fuel Transfer Pump

fuel transfer pumps in use on the Douglas A4D attack aircraft is driven by compressor bleed air. Pump's rated fuel flow is 10,000 lb.



per hr. from sea level to 15,000 ft. Air flow is less than 5 ft. per min. and mean room environmental temperature is 71°F.

Weight of the unit is 8.1 lb. and dimensions are 10 in. high and 7.1 in. maximum diameter.

Carlin-Wright Corp., P. O. Box 689,
Santa Barbara, Calif.

Liquid Oxygen Selector Valve

Segmented ball selector valve has been designed to handle liquid oxygen at -300°F under ambient temperatures from -70 to $+100^{\circ}\text{F}$.

More force exerted by the valve is down



inches. Bypass line size is 2½ in. Operating pressure is 1,100 psig. Actuation of the valve from full-open to full closed is 15 milliseconds by the electro-pneumatic method. Physical dimensions are 24½ in. x 9½ in.; weight

Kachles Aircraft Products Co., 406
Lee St., Dayton, Ohio



Retary Serve Actuator

Future work on sensors is designed primarily for adaption and elevator control on target domains.

ActiveStar has a torque rating of 70 in. lb at 5.5 rpm, with ratings up to 175 in. lb available. Internal reversing is for coasting and limit switches and a potentiometer furnishes operation range as an option at closed loop positioning system. Limits are offered for any angle up to 360 deg.

Argument Division of Universal
Match Co., 472 Paul Ave., St. Louis 35,
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... Or storage assemblies and components². Reactor core lifting and other core handling equipment, welded pressure vessels and small machined parts are all produced by DMC.

Projects with more than a touch of the unusual?—More U. S. Navy carriers have nine-boiler catapults. Just recently a Blue overtook because saved badly pilot and plane when a jet's hook failed. Right now you'll find sections of what will be

The world's most powerful radio telescope was assembled on the 400,000-square-foot floor of the Canton plant, one of two Kline plants in the U.S. In a word, Kline has the facilities and skills to take any job involving metal manufacturing from plan to finished product.

Whether you need a complete turn-key plant or quantities of precision machined parts, large or small, you'll be sure to get a deal from Blue.

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DOESHER Do 27 STOL plane is 34 ft 3 in. long and has a wingspan of 39 ft 4 in. Note "picture window" for passengers.

Ariston Week Pilot Report:

Do 27 Flight Range Starts at Near Hover

By Robert L. Stonefield



THIN AIRPLANE version of the Do 27 STOL plane, (Do 25, shown) is now in test status. Engines on this model are Lycoming O-560-A1A, mounted on low stub. Flight view of the Do 27 (below) emphasizes excellent forward and side visibility afforded the pilots.



Minneapolis—Flying from almost a hover to speeds as excess as 150 mph, Doer's single and versatile Do 27 STOL (short takeoff and landing) airplane showed itself particularly adaptable for operation into the smallest of airports and landing strips.

Single-engine airplane, all metal Do 27, Model C-1, was exhibited by Ariston Week at the Dorado West Coast Heliport, Chagrin Falls, Ohio, near Akron where the airplane is being produced both commercially and for the German air force.

Company plans to demonstrate two of these foot-poor aircraft in the United States, possibly this autumn. The four commercial versions include:

- Model G-2: Six-place airplane with a range of 510 mi. Empty weight is 2,310 lb., maximum is 3,550 lb. Engine is a Lycoming CG-480-B1A6 developing 274 hp at 2,400 rpm at sea level. Cost is approximately \$29,575.

- Model G-3: Four-place airplane with a range of 180 mi. Empty weight is 2,228 lb., maximum is 3,740 lb. Engine is a Continental R-470-K developing 216 hp at 2,600 rpm at sea level. Cost is approximately \$22,662.

- Model G-4: Six-place airplane which, with auxiliary fuel, will have range of 850 mi. Empty weight is 3,310 lb., maximum is 4,890 lb. Engine is a

Lycoming CG-480-B1A6. Cost is about \$27,575.

- Model G-2: Still in prototype stage, the airplane is expected to have a range of 160 mi., service ceiling of 25,000 ft. It has a maximum gross weight of 4,840 lb. Engine is a Lycoming CG-480-B1B0 developing 340 hp at 2,400 rpm at sea level. Propeller is three-bladed metal constant-speed Hartzell (Q) with 16 in. airfoil, two-blade, aluminum (Hartzell). Price will be approximately \$35,571.

The Do 27 also available with float) is particularly suited as a twin to be used as a float plane, due to its good takeoff and landing characteristics, as well as its applicability in a sportsvacation airplane. The four-place, two-engine is also adaptable, common with its airfoil, aluminum, as a float plane, and for agricultural and photographic purposes. Its various applications include utilization for aerial photo reconnaissance, ambulance service and as a personal transport.

Design Details

The airplane has a span of 39 ft 4 in., length of 34 ft 3 in. and height of 5 ft 9 in. (float plane version is 5 in. longer and has 3 in. less height than the airplane version). Each wing tank holds 75 gal. of fuel (55 gal. total). Refueling is done from the rear.

A fixed landing gear, slat runs the entire length of the main wing. Additionally, the entire span is covered and landing flaps in the inner span region. Both flaps and ailerons are double-slotted and fabric covered. Retractable wing tip flap, retractable.

Landings are combinations of nose gear and built-in wing section. The latter, at retract stage, permitting large view glass area for cabin occupants. Tailplane and fin are all metal, with control surfaces fabric covered.

The engine is a self-contained float gear, two main engine legs with aluminum shock absorbers, metal covered for stream lining. Engine cooling flaps open from two sides, downward from bottom opening propeller to cow ground-level maintenance.

Large glass area affords good visibility, both on the ground and in the air. Cockpit is built around four safety seats, in row, cabin compartment with all glass door hinged upward. Panel is hung over cabin and out of the cabin for emergency window access, which can be carried around at system of arm parts. Access to the baggage compartment at 55 in. ft., on port side of airplane, aft of cabin is via door of 3 ft 6 in. by 2 ft 7 in.

The Do 27 is naturally furnished with built-in retractable. The cabin



FLIGHT version of the Do 27 gets off the stop quickly as flaps are dropped during takeoff. Note rear vent flaps, which adds to stability of the airplane.



SHORT takeoff, shows short, is normal for the Doer's Do 27. A fixed landing gear, slat runs the entire length of the main wing. Both flaps and ailerons are double-slotted.



DOOR is passenger when put out of cockpit flaps upward. Out of view is the ceiling handles, which can be covered by a curtain. Seat at right faces aft.



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	SIZE	WEIGHT	POWER CONSUMPTION	COMPLEXITY	SOLDER CONNECTIONS
VACUUM TUBE	4 cu. in.	30 grams	2 watts	10	10
TRANSISTOR	1 cu. in.	2 grams	0.25 watts	10	10
SOLID STATE	0.001 cu. in.	0.001 grams	0.001 watts	10	10

Westinghouse laboratory produces molecular electronic systems 1/1000th of present size

Molecular electronics—a technological breakthrough at Westinghouse—is producing electronic systems 1,000 times smaller and lighter than anything now in existence.

Recently, the Air Research and Development Command of the U. S. Air Force awarded a development contract to Westinghouse as a part of a broad program effort in this new electronic area. Experimental "solidware" is being fabricated by Westinghouse for infrared, reconnaissance, communications, telemetry, flight control and other military applications for the Air Force.

For some time, the Solid State Advanced Development Laboratory of the Semiconductor Division, located at the Baltimore defense division, has been producing for special equipment applications a single material which accomplishes all the functions normally performed by several components in a conventional assembly.

Pictured above at right, a single wafer—less than $\frac{1}{16}$ " in diameter and about 1/100th of an inch thick—performs all the functions of much larger conventional and transistorized light modulated oscillators

shown at left and center. This tiny complete functional system, a light sensing device for satellite telemetry, is one of several including pulse generators, multiple switches and similar subsystems built and demonstrated by Westinghouse.

Through molecular electronics, drastic reduction in weight, size, power, and heat dissipation requirements will permit space vehicles and satellites to perform a greater number and wider range of tasks. Greatest advantage is vastly improved reliability achieved by the replacement of numerous components by a single solid state unit.

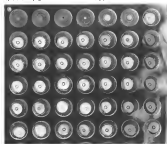
Westinghouse arrangement of component laboratory side by side with systems manufacturing facilities—unusual in industry—is providing a steady flow of information between component and systems scientists and engineers. A coordinated program involves the Air Arms Division, the Semiconductor Division, the Materials Engineering Department and the Research Laboratories. At all of these locations, continuing research is developing greater uses for this new approach to the building of better, more efficient electronic systems.



HIGH-SPEED GROWING of semiconductor crystals has been achieved by Westinghouse. Crystals are formed on a silver foil ribbon of liquid with cool kidneys. Method eliminates costly and time consuming sawing and polishing of germanium ingots, actually cuts assembly large loss of original material.



AUTOMATIC PRODUCTION of diodes at high speed and with great reliability may be possible as a result of molecular electronics. Shown above, individual diodes are sliced from ribbon following electrical connection. Each crystal in photo below is a self contained telemetry, performing all the functions of a component assembled with flow or top-down wiring, save the soldering point.



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These weather items prepared in consultation with the United States Weather Bureau

AIRPORT SAFETY DEVICES

LANDING AIDS

New landing aids are allowing pilots to make maneuvers over airport runways, even under poor weather conditions. For example, the flashing arrowboard lights shown in photo at left. Sequence-flashing lights create a readily appearing "finball" which accurately guides planes to the approach end of the runway.

Remote reading instruments and new observation methods are being used to report precise landing visibility measurements at major airports. They tell pilots what can be seen in flight rather than what is visible to an observer on the ground.

Runway Visual Range (RVR)—Electronic distance along runway at which pilot reaching down can expect to see high intensity runway lights. Measurements are determined by photo-electric Transmissometer.

Approach Light Center Height (ALCH)—Based on slant visual range of pilot. Green in terms of altitude in feet on the glide path at which a pilot can expect to see approach lights. ALCH is computed from measurements made by Transmissometer, Goniometer and other instruments. (In use at present only at Newark Airport, N. J.)

Arresting Beam Calculator—Electronic device which is calibrated to read maximum vertical visibility over the height of beam of clouds.



For safer landings... top performance at all times... it pays to rely on Mobil aviation products. There's Mobilgas Aviation, Mobilgrease fuels, Mobiloil Aero, Mobil hydraulic oils and greases. They all meet and exceed rigid U. S. Government specifications. Fly weather-wise. Fly Mobil.



There's "TRANSMITTER" every 1000 ft. up to 10,000 ft.

tailwheel is unstable through 160 deg. Little landing was necessary, though we did some slight S-turning since the area was a bit on the high side. After dropping 15 deg. at 1000 ft. the airplane was ready to roll.

Brakes were held in full power was applied, and as the airplane rolled farward, the tail immediately came up at 45 mph, after rolling about 250 ft. the Do 27 was airborne and at 5,000 rpm we were accelerating at 1,000 fpm. Power was held in 5,000 rpm through out climb to 5,000 ft. Was dropped off on 800 fpm, climb speed of 70 mph at 1,000 ft.

At a gross weight of 3,320 lb., gross fuelweight for the Do 27 to climb to 5,250 ft. in 3.6 min. to reach 9,540 ft. in 11.5 min. Service ceiling, at this weight, is 15,400 ft.

Climb at 10,000 ft. at 5,800 ft. was estimated at about 100 fpm (no figure was available). With power to 2,750 rpm, the airplane indicated 130 mph for a true airspeed of 145 mph. At this altitude we ran through a few stalls and tried some maneuvers.

Stall Characteristics

Power off, there are no true "locks" at stall speed. At about 40 mph there was no buffet, no wing drooping, just a slight nose-down pitch and full control, as speed built up, nose would sink. Dropping 15 deg. flaps then 30 deg.—airplane seemed to soar. With stick full back and no power device was a bit of 300 fpm.

During power-off descent, stick full back, the nose would come up in speed pulled up, then full nose again. Sharp turn was made during descent, nose low and high, but the aircraft remained quite stable.

Power was applied until engine turned 1,000 rpm and speed built up to 155 mph, at which point the air plane was looped. Then again, followed by an Immelmann. Do 27 was then flown straight up at steep angle, rolled around from which we pulled S down.

The airplane was "hung up" following a pullout from a glide speed of 160 mph. At top of a steep ascent 15 deg. at flaps was dropped and the inverted landed off to the "climb or a 'bump'." Airspeed indicator was too close to zero for a true reading.

The landing was proceeding in a 160 mph horizontal spin into the runway after which the airplane was again sharply pulled up, flaps dropped—then 15 deg.—then 45 deg.—during a wingover, and the airplane was brought back down, then a steep low level turn for a 30 mph power-on one-half drag over the runway. The Do 27 was dropped in and stopped within 50 ft.

Most impressive in the airplane's ability at low speeds. With proper trim,

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Designation of a new weapons system program at Raytheon Incorporated is automatically providing openings for former and former engineers with missile experience in the following areas:

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- Heat transfer
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- Target reference systems
- Wind-tunnel control
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- Ground support
- Electronic packaging
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- Electromechanical engineering background in missile control and autopilot design—project management
- Mechanical engineering background in ground handling of large missile systems—project management

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Phone—any business day, up to 6:00 p.m. Pacific Daylight Time—and an authorized Hughes engineer will evaluate your qualifications on the phone and advise you of specific opportunities. Your call, of course, is confidential—we are your subsequent correspondence.

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stock forms are light. Manufacture can be based on customer's wing with plus effective control surfaces. Total area of the 37 is 43 sq ft. Rudder area is 27.5 sq ft. and aileron area is 28.5 sq ft.

Package Do. 27 first flew in Spain in 1916, and production in Mexico began the first part of that year. Lockheed has continued for 428 Do. 27s, of which about 528 have been produced at the rate of 15 per month. Last delivery to Comair at Lima is scheduled for the spring of 1963.

Commercial Sales

Twenty commercial (civilian) models have been sold within the April-May period, these being pulled out of the military production line. Delivery dates are usually two to two-and-a-half months following date of order.

Domestic models have not states its output. Do. 28, a twin engine version of the 37/C, 27, came down from assembly carrying two 1500 hp engines. All engines of 150 hp each mounted on low wings (AW best 1 p. 53). Do. 29 isn't quite like Lockheed's single engine, it carries four engines, and Boeing plans to equip it with engines of 330-335 hp range. Cost would approximate \$40,000.

The Do. 27 electrical system is 24v. Cables in total are 1000 and an in-line switch also provides 1000. Where can be replaced by a 1000 switch operation, or a combination of switches can be utilized.

PRIVATE LINES

New distributor for S&W—two plus 1000 lightplane in Reading (Pa.) Aviation Service which will cover a 1000 airline territory.

Class A dealer appointed by Newark Corp. includes Baker Aviation, Mitchell Field, Milwaukee Wis. and Southern Ohio Aviation Co. James M. Cox, Manager Airport, Vandalia Ohio.

Three regional distributors have been appointed to handle. Navajo equipment Air Associates, Tetonville (N. Y.) Airport, Stroud, Pa. has been. Wichita, Kans. and Van Dusen Aircraft Supply, Dallas, Tex.

Reduction in flying experience required for pilots of the North Texas Air has been approved by Associated Airline Underwriters. Red. Underwriters report "The company, which the have full coverage, rate of 52 per 5000 annual value is not affected under new distribution, permitting and 30% to 75% of insurance. Being expensive actually required.

AVIATION WEEK, August 5, 1963

On Conair's new jet engine, this 800...

ONE **Pacific** THROTTLE CABLE REGULATOR
CONTROLS **16** CABLES!



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Controls 16 cables...
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The 100 is the...
The 100 is the...

To solve the problem of replacing throttle cables on Conair's 800 NHP jet engine... Pacific Scientific studies designed and built a NEW Cable Throttle Regulator that controls into one and cable regulator for all four of the 800's jet engines!

Each of the engines has two primary controls—and as each control utilizes two cables—this means the Pacific Regulator must handle a total of 16 cables!

Purpose of the new Pacific Cable Throttle Regulator Package is to compensate for change in cable lengths as a result of wing deflection and temperature changes—and to maintain cables at the exact tension at which they are tested, giving long-lasting engine control.

Cable regulation is important on jet transports as the high-speed wings present a wider latitude of deflection than conventional aircraft—and temperatures vary widely and faster due to higher rates of climb and cruising altitudes. Pacific Cable Throttle Regulators are the most effective means of proper setting for the thermal variation and the only device capable of compensating for mechanical deflections. Pacific engineers developed this new regulator for Conair's 800 where space and weight were at a premium. Their capacity and creative ingenuity are available to design a custom installation or fit an existing model to your specific control system needs. Write today for more information!

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ness. These alone, surely, are sufficient reasons why Chairman Frank Noel and many of his associates subscribe to *Business Week*. But why is General Dynamics also an important *Business Week* advertiser? Because management men everywhere—even your own best customers and prospects—rate it "most useful" of all general-business and news magazines. That's why you, too, will find many management reasons for your advertising dollar right here in *Business Week* that no other magazine is its field.



A. McCulloch Patterson

WHO'S WHERE

(Continued from page 25)

Changes

Sullivan Chapin appointed a consulting engineer to General Electric Co.'s Aircraft and Space Vehicle Department, Philadelphia, Pa.

The newly established Aeronautics Division of Chance Vought Aircraft, Inc., has announced the following appointments: J. E. Allen, director, market development and sales; E. C. Joseph, director, engineering; K. G. Smith, director, production; G. D. Shapiro, director, materials; J. E. Lohr, quality control manager; W. E. Korte, materials manager. Also the newly established Aeronautics Division announced the following appointments: A. Joseph, engineering manager; G. E. Shaw, manufacturing manager; W. C. Cripp, controller; M. R. Nelson, quality assurance manager.

Talbot Trepels, assistant director of engineering, Northrup Division of Rockwell International Corp., Seattle, N.Y.

Nathan Rindler, public relations manager, North American and Canadian Division of La Rocco.

Geoff W. Watts, director of European operations, Office France for Alcatel-Cable and Corp., Paris, Calif.

William H. Clark, general superintendent, Allen B. De Mott Laboratories, Inc., Edison, N.J.

United States Chemical Milling Corp., Manhattan, N.Y. has announced the following appointments: L. B. Mason, project manager, full range projects; Don C. Adams, director, Technical Department; J. T. Wavelength, chief engineer.

Dr. Joseph H. Vigness, director research and development, Irving Mikros, chief, technical planning and operations, Military Industrial Division of Inverness Electronics-Nor-South, Inc., Richmond, Va., N.Y.

Dr. William C. Kroyer, technical director IBM Federal Data Processing, South Plain, a division of I.T.S. Industries, Inc.

Robert K. Davis, sales manager/light equipment and Albert B. Kerkner, sales manager/telex communications, are the new appointments in the Sales and Engineering Division, Raytheon Co. Their new boss: Vice George A. Sordani, director of manufacturing services.

William C. Ransom, project engineer, general support equipment, Seleno Control Co., San Diego, Calif.

Ken Gendelsberg, chief engineer, technical Engineering Corporation of California, Los Angeles, Calif. His new Division: semiconductor manager.

Paul Rogers, market manager programs and equipment, Ch. Thompson-Kerr-Middlefield Products Co., Los Angeles, Calif.

Robert Ziemer, assistant director of job in electronics, United Veritrol Corp., East Hartford, Conn.

V. R. Bauman, assistant manager, Ted Deussen, Asst./Gen'l. Mgr. of Liquid and Solid Rocket Fuels, Sacramento, Calif. Fred Kinschulski, manager of development planning, United Electronics, Inc., Pasadena, Calif.

Engineers

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Radio systems (ground, airborne, mobile) • Radar Components (interceptors, transporters, indicators and alarms) • Digital data systems (radar, decoding, display)

Flight Control and Flight Instrument Systems

Transmitter Circuit Development • Gyroscopes • Systems Development • Electronic Components • Electro-Mechanical Components

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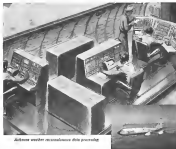
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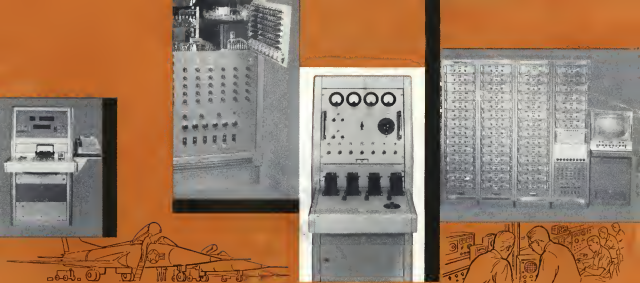
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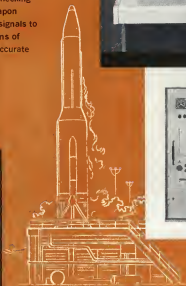
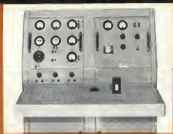
On flight lines and at missile launching sites...in production plants and depot maintenance centers...wherever speed and precision are vital, SMI test equipment capability meets the need with new levels of utility, repeatability...resolution...accuracy.

The SMI line of test equipment ranges from small, portable units that test single functions to console models that test complex airborne and missile electro-mechanical and electronic systems. Included in the line are pressure generation devices capable of generating static, differential and total pressures to simulate conditions from 1000 feet below sea level to 80,000 feet at speeds to Mach 5.

For example, SMI's TS 539 Air Data Computer Test Set is used for checking out elements of the Hughes Aircraft Company MA-1 aircraft and weapon control system. The TS 539 provides both electrical and pneumatic signals to the computer under test, achieving extremely high accuracy by means of electronically controlled force balance sensors. Mach readings are accurate to .7 millimachs and altitude readings within 15 feet at a speed of 1.4 Mach and an altitude of 30,000 feet.

Write today for further information on the TS 539 Air Data Computer Test Set and for details on SMI capability in test equipment.

Engineers: Investigate the opportunities available now at SMI in the fields of aircraft and missile instrument-control systems development.



LOS ANGELES OPERATIONS: 12500 Aviation Boulevard, Hawthorne, California

MECHATROL DIVISION: Westbury, L.I., New York

RESEARCH AND DEVELOPMENT CENTER: Goleta, California

The products of SMI are available in Canada and throughout the world through Servomechanisms (Canada) Limited, Toronto 15, Ontario